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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1957**

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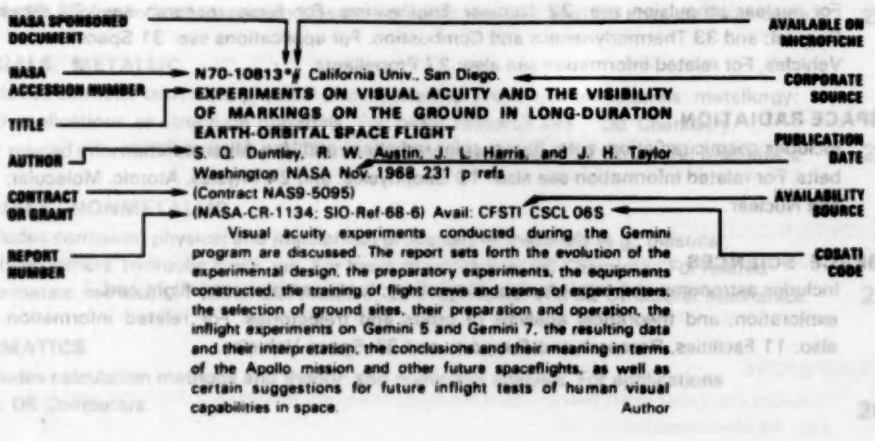
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
PUBLICATION DATE
Washington NASA Nov. 1968 231 p refs
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REPORT NUMBER
(NASA-CR-1134; SIO-Ref-68-6) Avail: CFSTI CSCL 06S
CSSATI CODE
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-23931# Naval Ordnance Lab., White Oak, Md.
AN EXPERIMENTAL INVESTIGATION OF THE FLOW FIELD AROUND A YAWED CONE Final Report
Robert H. Feldhuhn 3 Nov. 1969 83 p refs
(AD-699134; NOLTR-69-187) Avail: CFSTI CSCL 20/4

An experimental investigation of the flow field associated with a highly yawed cone was conducted at a Mach number of 5 and a free-stream Reynolds number per foot of 4,400,000. Surface static pressure measurements, flow-field surveys and schlieren photographs were obtained on a sharp five-degree semi-vertex angle cone at an angle of attack of 24 degrees. The results of the measurements indicate that the flow field on the leeward side of a highly yawed cone is very similar to that of a circular cylinder in supersonic cross flow. The essential difference between these two flow fields is the presence of a disturbance from the tip of the cone which separates the gas which has passed through the shock wave on the windward side from the flow which has passed through the weaker portion of the shock wave on the leeward side of the cone. Author (TAB)

N70-23979# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
EXPERIMENTAL DETERMINATION OF HELICOPTER TIP VORTEX GEOMETRY USING SMOKE Final Report, 10 May 1966 – 31 Aug. 1967
F. S. Stoddard and M. P. Scully Dec. 1969 18 p refs
(Contract DA-31-124-ARO(D)-470)
(AD-699415; ASRL-TR-142-1; AROD-6474-1-E) Avail: CFSTI CSCL 1/3

Experimental techniques were developed and proven to be successful as a means of providing correlation with the analytical treatment required to predict the actual tip vortex geometry of a helicopter rotor. The data were obtained by emitting smoke from the tip of one blade of a two-bladed rotor mounted in a wind tunnel so that the smoke is entrained by the tip vortex. The resulting smoke trace is photographed by a pair of cameras and a data reduction process is used to eliminate lens distortion and parallax. Author (TAB)

N70-23987*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW-FIELD INVESTIGATION FOR LARGE-ANGLE CONES WITH SHORT SPIKES AT A MACH NUMBER OF 9.6
W. Frank Staylor Washington Apr. 1970 39 p refs
(NASA-TN-D-5754; L-6317) Avail: CFSTI CSCL 20D

Tests were conducted with the models at zero angle of attack at a Mach number of 9.6. The test Reynolds numbers based on model diameter ranged from 60,000 to 230,000 and the model boundary layers were laminar for all tests. The parameter l/delta, the ratio of the spike-cylinder length to the bow-shock standoff distance at the stagnation point, determined the flow stability and the distributions of pressure and heating in the vicinity of the spike. For l/delta less than or equal to 0.7, the flow was detached from the spike tip and steady; for 1.1 less than or equal to l/delta less than or equal to 2.2, the flow was attached and steady; and for all other values of l/delta tested, the flow was unsteady. Heat-transfer measurements on the unspiked models were in good agreement with laminar predictions, and both the spiked and unspiked heating distributions were independent of Reynolds number. The total integrated heating increased with spike length and for steady, attached flow ranged from about 1.1 to 1.3 times the unspiked value. A semi-empirical method is presented that predicted the heating distributions for attached spike flow. Author

N70-24022# Naval Ordnance Lab., White Oak, Md.
AN EXPERIMENTAL INVESTIGATION OF THE COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH A FAVORABLE PRESSURE GRADIENT Final Report
David L. Brott, William J. Yanta, Robert L. Voisinet, and Roland E. Lee 25 Aug. 1969 81 p refs
(AD-699133; NOLTR-69-143) Avail: CFSTI CSCL 20/4

The paper describes the results of a detailed experimental investigation of a two-dimensional turbulent boundary layer in a favorable pressure gradient where the free-stream Mach number varied from 3.8 to 4.6 and the ratio of wall to adiabatic-wall temperature has a nominal value of 0.82. Detailed profile measurements were made with pressure and temperature probes; skin friction was measured directly with a shear balance. The velocity- and temperature-profile results were compared with zero pressure gradient and incompressible results. The skin-friction data were correlated with momentum-thickness Reynolds number and pressure-gradient parameter. Author (TAB)

N70-24025# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
MEASUREMENTS OF THE HYPERSONIC AERODYNAMIC CHARACTERISTICS FOR SEVERAL KINDS OF WAVE RIDERS
G. Kamimoto and Y. Uenaka Dec. 1968 30 p refs
(CP-25) Avail: CFSTI

This paper reports on wind tunnel studies of wave riders which might form the basis of future hypersonic aircraft. Eleven kinds of models are tested such as simple caret wings, halved Maikapar bodies and some special configurations. Lift and drag coefficients, lift-drag ratios, shock shapes and pressure distributions are measured using a hypersonic gun tunnel. Furthermore, the experimentally obtained data are compared with the theoretical value calculated by two dimensional theory. Author

N70-24040# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

HYPERSONIC AERODYNAMIC CHARACTERISTICS OF A FLAT-TOP WING BODY COMBINATION

G. Kamimoto and Y. Uenaka Dec. 1968 34 p refs

(CP-24) Avail: CFSTI

A brief discussion of available theoretical and empirical results for hypersonic aerodynamic characteristics of delta-winged half cone is given. Author

N70-24134# ARO, Inc., Arnold Air Force Station, Tenn.

AN EXPERIMENTAL INVESTIGATION OF SURFACE CONDITIONS ON HYPERBOLOIDS AND PARABOLOIDS AT A MACH NUMBER OF 10 Final Report, Apr. 1967 - Jan. 1969

Herbert R. Little Arnold Eng. Develop. Center Jan. 1970 141 p refs

(Contract F40600-69-C-0001)

(AD-698755; AEDC-TR-69-225) Avail: CFSTI CSCL 20/4

Data on analytic bodies are presented for Reynolds numbers from 22 to 65,000 (based on model nose radius) at a Mach number of 10. The test bodies are hyperboloids having asymptotic half-angles of 10, 22.5, and 45 deg and paraboloids; data are presented for steady-state skin temperatures, surface pressures, drag, and total skin friction. Shock-layer pitot pressure distributions are presented for two hyperboloids at selected Reynolds numbers. The results include an assessment of the modified Newtonian impact theory for use in inviscid pressure distributions. The effects of ciscous interactions on skin temperature, pressure, drag, and skin fraction are examined. Comparisons with numerical results of second-order boundary-layer and fully viscous shock-layer theories are made. Author (TAB)

N70-24175# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SPOILERS ON THE AERODYNAMIC CHARACTERISTICS OF A WING AND A SOLID OF REVOLUTION

A. M. Mkhitaryan et al 7 Aug. 1969 14 p refs Transl. into ENGLISH from the Russian

(AD-699258; FTD-HT-23-05-69) Avail: CFSTI CSCL 1/3

The results are presented of experimental investigations of the effect of vortex generators on the aerodynamic characteristics of streamlined bodies. Qualitative results are obtained which confirm the possibility of stabilizing the intact flow around a wing at large angles of attack. The results of an experiment on the flow around bodies of revolving vortex generators are presented. Coefficient of a revolving body on the Reynolds number for various conditions of flow are given. Author (TAB)

N70-24253*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SUBSONIC AERODYNAMIC CHARACTERISTICS OF A MODEL OF A FIXED-WING SPACE SHUTTLE CONCEPT AT ANGLES OF ATTACK TO 76 DEG

John P. Decker and Bernard Spencer, Jr. Washington Apr. 1970 52 p refs

(NASA-TM-X-1996; L-6985) Avail: CFSTI CSCL 01A

An investigation was conducted in the low-turbulence pressure tunnel on a model of the second stage (orbiter) of the two-stage space shuttle concept. The tests were conducted at angles of attack from about −7 deg to 76 deg to examine the subsonic pitch-down maneuver from high to low angles as well as to obtain some basic stability and control data at low angles of attack. The two-stage launch configuration was simulated for testing when the basic orbiter model was assumed to represent the first stage and a scaled second stage was placed in a piggyback fashion in the approximate location as conceptually proposed. The tests were conducted at a Mach number of approximately 0.25 at Reynolds numbers per foot from about 1.7 million to 12.3 million. Author

N70-24274*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

WIND-TUNNEL INVESTIGATION OF THE AERODYNAMIC PRESSURES ON THE APOLLO LAUNCH ESCAPE VEHICLE CONFIGURATION

William C. Moseley, Jr. and B. J. Wells (Federal Elec. Corp.) Washington Apr. 1970 70 p refs

(NASA-TN-D-5686; MSC-S-230) Avail: CFSTI CSCL 01A

A program of wind tunnel tests was conducted at Mach numbers from 0.4 to 9.08 to determine the pressure distribution on the Apollo launch escape vehicle. Data are presented for the angle-of-attack range from 0 to 136 deg. The data are plotted as the pressure coefficient versus the physical position of the pressure orifice to show some effects of the flow separator, of the escape-tower length, and of the angle of attack on the pressure distribution over the command module in the presence of the escape tower. Author

N70-24340# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

CALCULATION OF PLANE STEADY TRANSONIC FLOWS

Earll M. Murman and Julian D. Cole Jan. 1970 40 p refs Presented at the AIAA 8th Aerospace Sci. Meeting, New York, Jan. 1970

(D1-82-0943) Avail: CFSTI

Steady transonic flow past thin airfoils is formulated using small disturbance theory. The governing transonic potential equation is a nonlinear mixed differential equation. A boundary value problem is formulated and an analytical far field solution derived. For the near field a mixed finite difference system is developed to solve the transonic equation including cases with imbedded shock waves. Results are presented for nonlifting circular arc airfoils and a Nieuwland airfoil. Agreement with experiment for the circular arc airfoils, and exact theory for the shock free Nieuwland airfoil is excellent. Author

N70-24354# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

THE EFFECT OF COMBINED BOUNDARY-LAYER SUCTION AND BASE BLEED ON THE DRAG OF 10 DEGREE CONE AT M = 2.58

E. L. Goldsmith, N. A. Evans, and G. V. F. Smith London Aeron. Res. Council 1970 62 p refs Supersedes RAE-TR-67218; ARC-29946

(ARC-R/M-3591; RAE-TR-67218; ARC-29946) Copyright. Avail: CFSTI

It was shown experimentally at M = 2.58 that by removing a small quantity of air from the boundary layer through fine slits in the surface of a cone the transition Reynolds number can be increased. The air sucked from the surface was discharged into the cone base region, and it was shown that the measured axial force on the body at zero incidence was reduced over the whole test Reynolds number range. Author (ESRO)

N70-24356# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

MEASUREMENT OF THE YAWING MOMENT AND PRODUCT OF INERTIA OF AN AIRCRAFT BY THE SINGLE POINT SUSPENSION METHOD: THEORY AND RIG DESIGN

A. A. Woodfield London Aeron. Res. Council 1969 51 p refs Supersedes RAE-TR-68044; ARC-30530

(ARC-R/M-3607; RAE-TR-68044; ARC-30530) Copyright. Avail: CFSTI

The equations of motion for the single point suspension system are studied, and the method of analysis for determining the yawing moment and product of inertia is given. The presence of interference from a rocking mode is indicated, but the method of analysis is not affected. Design procedures are suggested which would minimize the interference from the rocking mode. Suspension

point flexibility is shown to be unimportant, as is also the effect of using a free spreader frame to lift the aircraft. Finally some analog computer results are given to illustrate the motions and the method of analysis. Author (ESRO)

N70-24358# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
A PILOTED SIMULATOR STUDY OF A SLENDER-WING RESEARCH AIRCRAFT (HP 115)
A. McPherson London Aeron. Res. Council 1970 37 p refs Supersedes RAE-TR-68068; ARC-30669
(ARC-R/M-3614; RAE-TR-68068; ARC-30669) Copyright. Avail: CFSTI

The HP 115 slender-wing research aircraft was represented on the Aero Flight piloted research simulator. Comparisons of the handling of the simulated and the actual aircraft were made, based on the subjective opinion of six experienced test pilots and on recorded time histories. As a separate exercise a variety of visual and motion cues was made available to the pilots. Their opinions and measurements of their ability to maintain wings level when subjected to step sidegusts, were used to assess the value of the several cues. Author (ESRO)

N70-24371# National Physical Lab., Teddington (England). Aerodynamics Div.
ESTIMATION OF SURFACE PRESSURES FROM OBSERVED SHOCK-WAVE ENVELOPES SURROUNDING CONICAL BODIES AT M = 4.0
M. J. Larcombe London Aeron. Res. Council 1970 18 p refs Supersedes NPL-AERO-1244; ARC-29349; See N68-24131
(ARC-CP-1085; NPL-AERO-1244; ARC-29349) Copyright. Avail: CFSTI

The shape of the shock wave surrounding a triangular-section conical body is constructed from photographs obtained with the use of a standard schlieren system. The location of the shock wave envelope is then utilized to calculate the surface pressure distributions, which show good agreement with experiment except in regions dominated by viscous effects. Author (ESRO)

N70-24450*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
EFFECT OF WING TIP CONFIGURATION ON THE STRENGTH AND POSITION OF A ROLLED-UP VORTEX
Raghuveera Padakannaya (M.S. Thesis) Mar. 1970 68 p refs
(Grant NGR-39-009-111)
(NASA-CR-66916) Avail: CFSTI CSCL 01A

The spanwise load distribution on plain rectangular wings and on wings with drooped tips was calculated by vortex lattice theory, to determine the effects of the droop on the strength and the location of the vortex. The load distribution on wings with drooped tips shows that the stronger vortex moves from the tip of the wing to the hinge of the drooped tip as the droop angle increases. The aim of the study was to determine how the vortex sheet shed initially from the wing's trailing edge rolls up and how these trailing vortices dissipate downstream of the wings. The results were obtained for wings with 0 deg, 70 deg, 80 deg, 90 deg, 110 deg droop angles, at approximately the same lift coefficient. The experimental results are presented as contours of constant vorticity to show the rolling-up of the trailing vortex sheet behind the different models. Results are also presented to show the strength and the induced velocity profiles of the rolled-up vortex generated by the models. Author

N70-24494# Cambridge Univ. (England). Dept. of Engineering.
THE CALCULATION OF THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS. PART 4: COMPARISON OF MEASUREMENTS WITH CALCULATIONS ON THE REAR OF A SWEPT WING
N. A. Cumpsty and M. R. Head London Aeron. Res. Council 1970 47 p refs Supersedes ARC-31029
(ARC-CP-1077; ARC-31023) Copyright. Avail: CFSTI

A boundary-layer development was measured on the rear of a wing swept at 61 degrees. The measurements approximately followed an external streamline from the neighborhood of the separation line. Unfortunately the flow was found to be surprisingly sensitive to traverse gear interference. Moreover, the constraint imposed by the wind tunnel walls was sufficient to throw grave doubts on the use of the assumption of constant spanwise velocity to compute the external flow behavior from the measured pressure distribution. Comparison of the measurements with calculations using the method proposed by Cumpsty and Head showed the growth of a streamwise momentum thickness, form parameter and crossflow to be seriously underestimated. However, only a small adjustment to the spanwise velocity outside the boundary layer over the rear of the wing was sufficient to bring the results into tolerable agreement. The necessity for such an adjustment to the spanwise velocity may be plausibly explained by the effect of tunnel constraints. Author (ESRO)

N70-24838# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
NUMERICAL PROGRAM AND EXAMPLES FOR DIFFRACTION OF SHOCK BY WINGS
F. Chow and M. Gunzburger Apr. 1969 80 p refs
(Grant AF-AFOSR-1062-67)
(AD-698834; AFOSR-69-2813TR; NYU-AA-69-8) Avail: CFSTI CSCL 1/3

The paper is intended to be a supplement for and should be used in conjunction with Diffraction of Shock Wave by Moving Thin Wing, L. Ting and M. Gunzburger, AFOSR-69-2814 TR. The numerical program used to determine the pressure is listed and various aspects of it are discussed. An extensive number of examples are given for the pressure on simple and composite symmetric thin wings. The lift on simple triangular wings with supersonic leading edges is also determined. Author (TAB)

N70-24739# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.
MEASUREMENTS OF PRESSURE DISTRIBUTION AROUND WING-BODY CONFIGURATIONS WITH BLUNT BODIES [DRUCKVERTEILUNGSMESSUNGEN AN FLUEGEL-RUMPF-KOMBINATIONEN MIT DICKEN RUEMPFEN]
H. Koerner 1969 41 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The subsonic flow pressure distribution on the surfaces of wing-and-body configurations were measured, and the lift distributions over the spans were determined. The results are compared with the theoretical results obtained by means of the RAE standard method. ESRO

N70-24756# Technische Univ., Berlin (West Germany). Hermann-Foettinger-Inst. fuer Stroemungstechnik.
DRAG MEASUREMENTS ON OSCILLATING CYLINDERS UNDER VARIOUS CONDITIONS WITH A VORTEX STREET AT SMALL REYNOLDS NUMBERS [WIDERSTANDSMESSUNG AN SCHWINGENDEN ZYLINDERN UNTER VERSCHIEDENEN ZUSTAENDEN MIT IHREM NACHLAUF BEI KLEINEN REYNOLDSZAHLEN]
M. Sedrak 1969 16 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The variation of the mean drag of a vibrating circular cylinder in a transverse flow as a function of the excitation amplitude and

frequency was measured in an open wind tunnel at a low turbulence level. A micro-torsion balance was developed for direct measurements to avoid using the von Karman formula which does not apply rigorously. It appeared that the periodic vortex of an oscillating cylinder behaves like a nonlinear oscillator under forced vibration. The cylinder drag is linearly proportional to the excitation amplitude. ESRO

N70-24801*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND TWO-DIMENSIONAL CASCADE TEST OF TURBINE STATOR BLADE WITH RATIO OF AXIAL CHORD TO SPACING OF 0.5

Roy G. Stabe Washington Apr. 1970 21 p refs

(NASA-TM-X-1991; E-5490) Avail: CFSTI CSCL 20D

Blades were designed for a velocity diagram typical of the first-stage stator of a jet engine turbine and were tested in a simple two-dimensional cascade of six blades. The principal measurements were blade surface static pressure and cross-channel surveys of exit total pressure, static pressure, and flow angle. The results of the experimental investigation include blade loading in terms of the blade surface pressures and overall performance in terms of the loss and blade loading coefficients. A comparison is also included of the experimentally and analytically obtained blade surface velocity distribution and the cross-channel variation of velocity and flow angle. Author

N70-24934# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

WEAK INTERACTION ON CONES AT SUPERSONIC AND HYPERSONIC FLOW: A SURVEY [WEAK INTERACTION AN KEGELN BEI UEBER- UND HYPERSCHALLANSTROEMUNG: EIN UEBERBLICK]

H. H. Album (USAF) and H. P. Karelitz 1969 73 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

At supersonic and hypersonic Mach numbers and low Reynolds numbers, i.e. flying conditions at great heights, the boundary layer grows at such a great rate that non-viscous flow is greatly modified and this in turn reacts on the boundary layer, etc. This process, known as viscous or weak interaction, requires special methods of computation for investigating the pressure, resistance and heat transfer of the nose cones of reentry vehicles, high altitude flight systems and propulsion system inlets. A literature survey of the work carried out on the above weak interaction with cones is given. Theoretical and experimental pressure ratios are compared and the reliable computation methods and results are indicated. ESRO

N70-24935# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.

INVESTIGATION OF EXTERNAL HYPERSONIC COMBUSTION [UNTERSUCHUNGEN ZUR AEUSSEREN UEBERSCHALLVERBRENNUNG]

M. Kallergis 1969 15 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

The aerodynamic phenomena occurring in the supersonic flow around pyramidal bodies propelled by external combustion engines were investigated. The shock waves formed in the combustion area behind the body were responsible for lift and thrust pressures when impinging onto the rear wall of the body. ESRO

N70-24944# Entwicklungsring Sud, Munich (West Germany). Arteilung Aeroelastik.

COMPARISON OF MEASURED AND CALCULATED UNSTEADY PRESSURE DISTRIBUTIONS FOR HIGH SUBSONIC FLOW AROUND AN ELASTIC SWEPT-BACK WING [VERGLEICH GEMESSENER UND BERECHNETER INSTATIONAERER DRUCKVERTEILUNGEN FUER DEN HOHEN UNTERSCHALL AN EINEM ELASTISCHEN GEPFEILTEN FLUEGEL]

J. Becker Sep. 1969 31 p refs In GERMAN Presented at the DGLR Ann. Meeting, 22-24 Sep. 1969

(EWR-403-69) Avail: CFSTI

In contrast to the lower subsonic range, there have been few comparisons of theoretical and experimental values for unsteady aerodynamic forces in the high subsonic and transonic ranges. Corresponding pressure distribution measurements at the NLR (Amsterdam) on harmonically oscillating swept-back wings, showed general agreement between experiments and recent theories. The oscillations were elastic and the range of reduced frequencies extended to $k = 2.0$. The experiments and results are described and some measured pressure distributions of different oscillation modes are compared with theoretical values. The influence of the different parameters (oscillation mode, frequency, Mach number) are plotted. Tendencies in the transonic range, and a possible transfer of measured pressure distributions to unmeasured ones are indicated. ESRO

N70-25058# Royal Aircraft Establishment, Farnborough (England).

THE INVESTIGATION OF THE FLOW IN THE VICINITY OF V SHAPED WINGS FORMED BY STREAM SURFACES BEHIND A PLANE SHOCK WAVE [ISSLEDOVANIE TECHENIYA V OKRESTNOSTI V-OBRAZNYKH KRYLEV OBRAZOVANNYKH POVERKHNOSTYAMI TOKA ZA PLOSKIM SKACHKOM UPLOTNENIYA]

V. V. Keldysh Oct. 1969 13 p refs Transl. into ENGLISH from Mekhan. Zhidkosti i Gaza, no. 4, 1967 p 50 - 55

(RAE-Lib-Trans-1407) Avail: CFSTI

When calculating the flow past bodies with plane sides and sharp edges it is assumed that whenever the shock wave is attached it may be determined in a section normal to the edge, according to the corresponding relationships for a two-dimensional wedge. A solution corresponding to a weak shock on a wedge with supersonic velocity behind it is selected. Although in the plane case (wedge) this solution is the sole physically realisable one, in the case of three-dimensional bodies when a velocity component along the leading edge exists it is also possible to conceive in the section normal to the edge the realisation of a second solution. This corresponds to a wedge with a strong shock wave, provided that in the three-dimensional case the full velocity behind it (taking into account the velocity component along the edge) is supersonic. Relative to the velocity of the non-perturbed flow both these solutions correspond to a weak shock wave. We shall give an example when the solution with a strong shock wave in the section normal to the edge is found to be possible. Author

N70-25067# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

DESCRIPTION AND ELABORATION OF UNSTEADY WIND GUST DERIVATIVES OF THE LONGITUDINAL MOTION OF AIRCRAFT [BESCHREIBUNG UND AUSWIRKUNG INSTATIONAERER BOENDERIVATIVA DER FLUGZEUGLAENGSBEWEGUNG]

G. Schaenzer 1969 42 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

After estimating wind gust power spectra it is shown that a quasi-stationary approach is sufficient for the relatively slow flight path motion of an aircraft. Quasi-stationary derivatives are deduced

for horizontal and vertical wind gust influences and compared to known quasi-stationary derivatives and to calculations in unsteady conditions. The results of vertical and horizontal wind gust disturbances on longitudinal aircraft motion, especially the all-pass effects caused by unsteady flow, are discussed with the aid of Bode diagrams and transient responses for two different aircraft. ESRO

N70-25068# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aerodynamik.

ON THE DRAG PROBLEM OF SLENDER BODIES WITH ZERO LIFT IN HYPERSONIC FLOW [ZUM WIDERSTANDSPROBLEM SCHLANKER KOERPER BEIM NULLAUFTRIEB IN UEBERSCHALLSTROEMUNG]

A. Das, P. Krux, and J. Wellmann 1969 55 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969 Avail: CFSTI

Different theories of hypersonic flow around slender bodies are compared. The pressure distribution and the wave resistance are calculated for some ideal bodies, and the results are compared with experimental data collected in a hypersonic wind tunnel. The geometry of slender bodies is optimized for minimum drag at zero lift taking into account friction drag. ESRO

N70-25086# Army Missile Command, Redstone Arsenal, Ala. Advanced Systems Lab.

PRESSURE MEASUREMENTS ON FOUR CONE-CYLINDER-FLARE CONFIGURATIONS AT SUPERSONIC SPEEDS

William D. Washington and James A. Humphrey 20 Oct. 1969 281 p

(AD-699359; RD-TM-69-11) Avail: CFSTI CSCL 20/4

Pressure distribution data are presented for four cone-cylinder-flare configurations at Mach numbers of 1.75 to 4.5. The angle of attack range was from -4 to +12 degrees. Roll angles ranged from 0 to 180 degrees. The Reynolds number remained constant at approximately 450,000 per inch. The boundary layer was made turbulent with a grit ban. The basic pressure data are presented in tabular form with the test conditions printed on each table. Author (TAB)

N70-25137# National Center for Atmospheric Research, Boulder, Colo.

FORCES IN A CABLE-RESTRAINED BALLOON SYSTEM

Jack M. Angevine and David W. Fulker Feb. 1970 119 p refs Supported by NSF

(NCAR-TN-47) Avail: Issuing Activity

A complete analysis of the forces acting on a cable-restrained balloon launch system and describes computer programs that may be used to determine optimum system configurations is presented. The computer programs are applicable to either Stonehenge or vehicle launch systems, and solutions to a typical problem are given. Computer program listings appear as appendices. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-23994*# National Center for Atmospheric Research, Boulder, Colo.

A JETTISON FITTING FOR MULTIPLE BALLOON SYSTEMS Final Report

Jack M. Angevine Oct. 1969 25 p

(Contract NASr-185)

(NASA-CR-109452) Avail: CFSTI CSCL 01C

Requirements were determined for a balloon coupling, or transfer fitting, which allows the balloons of a multiple balloon system to be separated in flight, thereby enhancing system performance. Detail prototype design was completed and the major subassembly fabricated. The concept and design are described by reference to the design layout and photographs of the prototype hardware. Author

N70-24031# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

AIRCRAFT DESIGN PROJECT 1969: AN AGRICULTURAL AIRCRAFT

Dec. 1969 89 p

(TT-6919) Avail: CFSTI

The design and performance of an agricultural aircraft are presented. The design features include good takeoff and landing performance from small unprepared strips, safe operating speed of 60 to 100 mph, good maneuverability and handling, good pilot visibility, pilot protection in event of crash, fire protection by keeping fuel tanks away from the engine, simplicity of construction and maintenance, and good payload with provision for rapid loading. A side by side hopper/pilot arrangment provides a good solution to conflicting requirements. A gas turbine engine was originally chosen, but was shown to be unwise due to the initial cost. Weight and cost analyses, loading estimates, and stability and control are also discussed. N.E.N.

N70-24091# Army Aviation Material Labs., Fort Eustis, Va.

PAPERS PRESENTED AT THE ELASTOMERIC SYMPOSIUM

18 Mar. 1969 112 p refs Conf. held at Fort Eustis, Va., 18 Mar. 1969

(AD-698477) Avail: CFSTI CSCL 1/3

Contents: Elastomeric laminar bearing analysis; Design and development of an elastomeric-bearing rotor hub; Elastomeric bearings for UH-2 helicopter tail rotor articulation; Potential of elastomeric bearings for rotor applications; History, application, and experience with elastomeric bearings of the Enstrom model F-28A helicopter. TAB

N70-24159# Army Transportation Engineering Agency, Fort Eustis, Va.

HELICOPTER EXTERNAL SLING SYSTEM BASIC VIBRATION DATA

George M. Cottingham Dec. 1969 13 p refs

(AD-699371; USATEA-69-14) Avail: CFSTI CSCL 13/5

Simulated tests were conducted of helicopter externally slung loads ranging from 2,000 to 4,000 pounds on an analog computer. Author (TAB)

N70-24202# Boeing Co., Renton, Wash. Commercial Airplane Div.

USE OF RUNWAY CONDITION METHOD TO PREDICT BRAKING PERFORMANCE Technical Note

N. S. Attri Dec. 1969 36 p

(AD-699476; D6-58384-18TN) Avail: CFSTI CSCL 1/5

Both the U. S. Air Force and FAA currently use James Brake Decelerometer to measure the runway condition and to enable the prediction of braking performance. A new method has been recently developed which also can be used to predict braking

performance and uses runway condition reading as a measure of ground mu. The paper discusses both methods of predicting the braking performance. Author (TAB)

N70-24203# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
THE INFLUENCE OF NOISE LEVEL DURATION CORRECTION ON NOISE AND NUMBER INDEX
D. M. Waters and C. S. Waters Dec. 1969 16 p refs
(TT-6918) Avail: CFSTI

The calculation of the time history of an aircraft flyover is described and related to the calculation of the effective perceived noise level from the peak perceived noise level of the aircraft. The decay of EPNdB with distance is shown and the effect of this modified rate of decay on the calculation of the Noise and number index is investigated. This effect is illustrated with reference to the published NNI contours for a third London airport at Foulness. Author

N70-24210# Army Natick Lab., Mass. Airdrop Engineering Lab.
A PARACHUTE RETROROCKET RECOVERY SYSTEM FOR AIRDROP OF HEAVY LOADS Technical Report
George Chakoian Nov. 1969 35 p refs
(AD-699342; TR-70-34-AD) Avail: CFSTI CSCL 15/7

The report presents the results of an in-depth exploratory development study of a parachute retrorocket recovery system for the airdrop of cargo loads weighing up to 50,000 pounds and the results of actual drop tests of loads weighing from 3000 to 35,000 pounds. The study indicates that a parachute retrorocket recovery system is particularly feasible for the recovery of airdrop loads and may prove to be the only practical system for heavy loads, especially if low altitude is a requirement. Author (TAB)

N70-24224*# Battelle Memorial Inst., Columbus, Ohio.
EVALUATION OF THE GUST-ALLEVIATION CHARACTERISTICS AND HANDLING QUALITIES OF A FREE-WING AIRCRAFT
Richard F. Porter and Joe H. Brown, Jr. Washington NASA Apr. 1970 154 p refs
(Contract NAS2-5116)
(NASA-CR-1523) Avail: CFSTI CSCL 01C

An analytical investigation was performed to evaluate the dynamic characteristics of aircraft employing an unconventional wing, free to pivot freely about a spanwise axis forward of its aerodynamic center and subject only to aerodynamic moments imposed by lift and drag forces and a trailing-edge control tab. The left and right wing panels operate independently, with symmetrical tab displacement being used to control the angle of attack and differential tab deflections causing asymmetric panel deflections for lateral control. Three hypothetical subsonic aircraft were considered, ranging in gross weight from 3000 to 50,000 pounds. The influence of the free-wing concept was determined by comparing the turbulence penetration performance and handling qualities for each free-wing aircraft and the equivalent conventional aircraft. While longitudinal handling qualities appear to be satisfactory, an artificial roll damper was found to be beneficial to the lateral control characteristics because of inherent low roll damping and spiral divergence. With the roll damper augmentation, the lateral-directional control characteristics are excellent. The very powerful roll control provided by differential panel displacements, and the reduced gust sensitivity, would be particularly beneficial during low-speed approaches in rough air. Author

N70-24238# Boeing Co., Renton, Wash. Commercial Airplane Div.
ADVANCES IN DESIGN CRITERIA FOR AIRLINE BRAKING SYSTEMS Technical Note
N. S. Attri and R. L. Amberg Dec. 1969 53 p refs
(AD-699475; D6-58384-17TN) Avail: CFSTI CSCL 1/3

The paper discusses some of the research studies pertaining to self-induced brake vibration (squeal), which is part of a study to eliminate landing gear system problems. Experimental tests were designed to provide data on brake friction lining characteristics which result in brake squeal. The results of these tests are discussed qualitatively. Theoretical studies were aimed at understanding the mechanism of brake squeal and the role various brake design parameters play in self-induced vibrations. An analog computer simulation was also used to determine the influence of negative slope and other variables. Author (TAB)

N70-24288# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
WIND TUNNEL MEASUREMENTS OF THE LOW SPEED STALLING CHARACTERISTICS OF A MODEL OF THE HAWKER-SIDDELEY TRIDENT 1C
D. Isaacs London Aeron. Res. Council 1967 61 p refs
Supersedes RAE-TR-68108; ARC-30775
(ARC-R/M-3608; RAE-TR-68108; ARC-30775) Copyright. Avail: CFSTI

Tests were made in the 8 ft × 8 ft wind tunnel on a 1/18.86 scale model in order to investigate Reynolds number and Mach number effects on the low speed stalling characteristics. In particular, lift and pitching moment measurements were obtained in conjunction with flow visualization studies using tufts attached to the wing upper surface. The results obtained effectively demonstrate the importance of testing accurate models at sufficiently high Reynolds numbers, and of the necessity of separating Reynolds number effects from Mach number effects, if realistic values are to be obtained in wind tunnel tests. Author (ESRO)

N70-24303# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THE PROBABILITY OF DETECTION OF AIRCRAFT BY VISUAL OBSERVATION [DIE ENTDECKUNGSWAHRSCHEINLICHKEIT VON FLUGZEUGEN UNTER VISUELLER BEOBACHTUNG]
Werner Glanzmann (Ph.D. Thesis) 1969 110 p refs
(Diss-4273) Avail: CFSTI

Operations research studies were made for the evaluation of a new fighter plane for the Swiss Air-Force. One part of these studies was to determine the probability of detection of aircrafts by visual observation. This particular knowledge is necessary to calculate the probability of survival of aircrafts at mission. The model was developed for single-seat fighters. Its conception is such that it may be used also for fighter detecting observers on the ground. The mathematical base is the Poisson process. The laws of eye-physiology were incorporated. Unknown constants have been determinated by a likelihood estimation. Flight experiments were carried out quite especially for that purpose. The model was tested by comparing the empirical distribution function with the true distribution function of the detection probability. The test was made on flight experiments selected at random. Author

N70-24373# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
LOW ALTITUDE TURBULENCE MEASUREMENTS OVER LAND AND SEA DURING FLIGHTS IN A CANBERRA AIRCRAFT
E. W. Wells London Aeron. Res. Council 1970 27 p refs
Supersedes RAE-TR-69129; ARC-31483
(ARC-CP-1081; RAE-TR-63129; ARC-31483) Copyright. Avail: CFSTI

A number of flights were made at low altitude by a Canberra aircraft over a route in the U.K. which included legs flown over land, and also over the sea at three and fifteen miles from the coast. Counting accelerometer records were analysed and the turbulence encountered on the three legs compared. A brief analysis was made of the effect of wind on the turbulence. Author (ESRO)

N70-24631# Naval Air Engineering Center, Philadelphia, Pa.
AIRCRAFT WEIGHT CONFIRMATION UNIT OPERATION AND MAINTENANCE MANUAL WITH ILLUSTRATED PARTS BREAKDOWN
Francis S. Ciccarone 21 Nov. 1969 24 p
(AD-699511; NAEC-ENG-7578) Avail: CFSTI CSCL 9/3

The manual describes the operation and maintenance of the Aircraft Weight Confirmation Unit, NAEC. Also, unit malfunctions which may occur are described and necessary corrective actions are indicated. An illustrated parts breakdown is also included in the manual. Author (TAB)

N70-24733# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
CONTRIBUTION TO THE INTERFERENCE PROBLEM OF PROPULSION UNITS MOUNTED ABOVE THE AIRPLANE WING [BEITRAG ZUM INTERFERENZPROBLEM VON UEBER DEM TRAGFLUEGEL ANGEORDNETEN TRIEBWERKEN]
J. Barche 1969 31 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

Interference problems between the wings and the propulsion unit on one hand, and between the propulsion unit and the horizontal tail surfaces on the other are discussed and solutions based on research on the local-distance passenger aircraft VFW 614 are outlined. ESRO

N70-24740# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
THE VTO TILT-WING TRANSPORT AIRCRAFT VC 400 [DER VTO-KIPPFLUEGEL-TRANSPORTER VC 400]
H. Hoeppner 1969 41 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The design of a tilt-wing propeller driven transport aircraft is described, and its advantages compared to other types are discussed. The flight characteristics in vertical climbing flight, transition flight, and high speed flight are considered, and the appropriate design parameters are given. ESRO

N70-24745# Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
BLOW-OUT, A MEANS FOR THRUST AUGMENTATION OF VSTOL PROPELLERS [AUSBLASUNG, EIN MITTEL ZUR SCHUBSTEIGERUNG VON V/STOL-PROPELLERN]
A. Mueller 1969 28 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The static thrust and power of fast flight propellers which obtain thrust augmentation by means of air blown out of slits, were determined using models. Blow-out beneath the profile and the radial blow-out at the blade tip were investigated. It is shown, that both methods result in improvement of the static thrust and the thrust-power ratio in the upper power range. However radial blow-out at the side of the blade necessitates less air and results in a stronger construction. ESRO

N70-24755# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Lehrstuhl fuer Flugmechanik und Lehrstuhl B fuer Mechanik.
GUST INFLUENCE ON AIRCRAFT DYNAMICS DURING LANDING APPROACH [BOENEINFLUESSE AUF DIE DYNAMIK EINES FLUGZEUGS BEIM LANDEANFLUG]
Peter Hamel and Fritz G. Buchholz 1969 26 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The dynamic behavior of a slender delta-wing aircraft under the influence of vertical and lateral gusts during landing approaches was investigated, particular attention was given to the gradients of lateral shear flow. The linearized equations of motion were established and the Bode-sensitivity of the gust transfer functions were determined analytically. The original aircraft design was improved, after treatment by an analog computer, to give zero gust sensitivity. ESRO

N70-24757# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DETERMINATION OF THE STABILITY DERIVATIVES FROM FLIGHT TEST DATA BY MEANS OF REGRESSION ANALYSIS [ERMITTLUNG DER STABILITAETSDERIVATIVA AUS DEN FLUGVERSUCHSERGEBNISSEN MIT HILFE DER REGRESSIONSANALYSE]
H. Friedrich 1969 47 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22 - 24 Sep. 1969
Avail: CFSTI

The flight test data in digital format obtained both in simulation and actual flight tests of the DO 31 aircraft were subjected to a computerized regression analysis in order to obtain the stability derivatives of the aircraft. The advantages of digital data recording and the principles of the regression analysis are outlined. ESRO

N70-25069# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
THE DEVELOPMENT OF AN INTEGRATED FLIGHT CONTROL SYSTEM FOR MODERN HIGH-PERFORMANCE AIRCRAFT [DIE ENTWICKLUNG EINES INTEGRIERTEN FLUGSTEUERUNGS- UND -REGELUNGSSYSTEMS FUER MODERNE HOCHLEISTUNGSFLUGZEUGE]
H.-G. Schumann and R. Staufenbiel 1969 25 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

A short description of the development, systems concept, and the system components of a fly-by-wire system for an operational VTOL aircraft is given, as well as some results of its laboratory, ground and air trials. ESRO

N70-25071*# Northrop Corp., Newbury Park, Calif. Ventura Div.
FREE FLIGHT INVESTIGATION OF LARGE ALL-FLEXIBLE PARAWINGS AND PERFORMANCE COMPARISON WITH SMALL PARAWINGS Final Report
J. H. Moeller, E. M. Linhart, W. M. Gran, and L. T. Parson Mar. 1970 301 p refs
(Contract NAS1-7467)
(NASA-CR-66918) Avail: CFSTI CSCL 01C

Results of a series of twenty aerial drop tests conducted with 4000 sq ft planform area (intermediate-scale) all-flexible parawings are presented. Both single keel and twin keel parawing models were tested. The aerial drop tests with the intermediate-scale parawings demonstrated the feasibility of their deployment within the prescribed deployment envelope. However, the tests showed that the larger parawings, in the configurations tested, were susceptible to localized, canopy cloth damage in the early stages of deployment, particularly at the higher initial dynamic pressures. The tests confirmed the need for a five-stage deployment process to maintain deployment decelerations at or near the 3 G level. For the parawing in gliding flight, the tests showed the larger parawings to be stable, controllable, and responsive to turn commands. In straight, gliding flight the intermediate-scale, twin keel parawings demonstrated a maximum lift-to-drag ratio of 2.5 to 2.75, depending on wing loading. Author

N70-25072# Royal Aircraft Establishment, Farnborough (England).
KINEMATICS OF LEE-WAVE FLOW. PART 2: TURBULENCE OF LEE-WAVE FLOW

W. Georgii May 1969 26 p refs Transl. into ENGLISH from German Report DLR-FB-68-38
(RAE-Lib-Trans-1318; DLR-FB-68-38) Avail: CFSTI

Turbulence as felt by a passenger in a commercial aircraft is produced by two mechanisms (2) exogenous, by the turbulence of the airstream, (2) endogenous, by the change of flight conditions. Strong turbulence of the lee-wave flow is observed in the rotors of the middle troposphere. This type of strong turbulence is produced by the so-called waterfall, by wind shear above 0.03/sec and in the tropopause rotors by maximum parameter values theta squared with constant or increasing wind velocity. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-23945# Los Alamos Scientific Lab., N. Mex.
THERMAL ANALYSIS OF A THERMIONIC DIODE
C. D. Sutherland 9 Jul. 1969 16 p refs
(Contract W-7405-eng-36)
(LA-4215) Avail: CFSTI

A mathematical model is described which was used to determine the performance of a cylindrical thermionic diode. Experimentally determined current–voltage characteristics at constant cesium pressure are used to determine emission–current density as a function of emitter temperature and voltage. Numerical solutions of the system of first-order differential equations comprising the model have been used to determine optimum electrical power output and efficiency for a single thermionic diode as a function of emitter length. Results are also given for the optimum performance of a thermionic fuel rod containing series-connected thermionic diodes in which there is an axial variation of thermal power density. Author (NSA)

N70-23985# Army Electronics Command, Fort Monmouth, N.J.
ULTRA-RELIABLE POWER PROCESSOR FOR HYDROCARBON-AIR FUEL CELL POWER SYSTEMS
Melvyn S. Kosmin Nov. 1969 26 p refs
(AD-699311; ECOM-3197) Avail: CFSTI CSCL 10/2

A 50 ampere power processor for shelter mounted hydrocarbon-air fuel cell power systems is described. The processor converts raw fuel cell power to the precise, high quality power required by military communications-electronic equipment. It is characterized by high efficiency (greater than 90%), high reliability (10,000 hours MTBF), and light weight, accomplished through the use of advanced high frequency, current controlled, switch modulation techniques. Automatic protection of the fuel cell against overloads, reverse current, and undervoltage operation is provided. A unique function of the processor is that it optimally loads the fuel cell to aid in system bootstrapping for faster start-up. Current limiting allows parallel operation when higher power levels are required and provides a battery charging capability. Interface compatibility with the fuel cell, battery and load, and ancillary items are also discussed. Author (TAB)

N70-23989*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF REYNOLDS NUMBER ON OVERALL PERFORMANCE OF A 6-INCH RADIAL BLADED CENTRIFUGAL COMPRESSOR
Laurence J. Heidelberg, Calvin L. Ball, and Carl Weigel Washington Apr. 1970 25 p refs
(NASA-TN-D-5761; E-4879) Avail: CFSTI CSCL 10A

Overall performance is presented over a range of compressor inlet pressures from a nominal 1.5 to 8.6 psia and corresponding Reynolds number range of 320,000 to 1.8 million. As inlet pressure and thus Reynolds number was decreased, a progressive degradation in efficiency along with a lowering of the surge and maximum flow points was observed. These changes in performance are explained in terms of changing viscous losses and changing effective flow areas with Reynolds number. A comparison between the data and the commonly used 0.2 power of Reynolds number relation to loss is made. Author

N70-24017# Pennsylvania State Univ., University Park. Coll. of Earth and Mineral Sciences.
FACTORS IN THE DESIGN OF POROUS ELECTRODES FOR PRIMARY ELECTROCHEMICAL CELLS
L. G. Austin and E. G. Gagnon May 1969 43 p refs
(Contract DAAG 39-67-C-0065)
(AD-698487; Rept-3) Avail: CFSTI CSCL 10/3

The purpose of the work was to apply the theories of porous electrode behavior to thin, porous electrodes used at low ambient temperatures, to show how performance is affected by the relevant factors involved. The system chosen for study was the Ag-AG2O electrode operating in the low-freezing eutectic of aqueous KOH as electrolyte. The report describes the complexity of the cathodic discharge curve; voltage varied with discharge time in six distinct regions. One of these regions, a plateau of almost constant potential was studied in detail. The current density-voltage-temperature relations for this region followed a Tafel equation, with an activation energy of exchange current of 14.5 kcal/mole. For this system an analytical solution was obtained for the equation of behavior. Results from this solution agreed reasonably well with experimental results. In addition, the theory was used to predict the distribution of reaction throughout the electrode and experimental results agreed well with predicted. It is shown how the theory can be used to predict optimum electrode thickness, and how porosity, internal area, and electrolyte conductivity affect the result. Author (TAB)

N70-24198# Army Electronics Command, Fort Monmouth, N.J. Power Sources Div.
LIFE AND PERFORMANCE CHARACTERISTICS OF Pb-Te COUPLES IN HYDROCARBON FIRED SYSTEMS
Andrew Herchakowski Dec. 1969 16 p refs
(AD-699312; ECOM-3199) Avail: CFSTI CSCL 10/2

The report describes life test data on 16-couple and 12-couple modules, designed for use in hydrocarbon fuel fired systems. These modules utilize segmented 3N/4N Pb-Te for the N leg and 2P Pb-Te for the P leg. Significant progress utilizing these couples in exploratory development models is discussed. Author (TAB)

N70-24352*# AiResearch Mfg. Co., Phoenix, Ariz.
THE DESIGN AND FABRICATION OF THE BRAYTON ROTATING UNIT OPERATING ON ROLLER ELEMENT BEARINGS (BRU-R) Final Report
B. B. Heath and R. A. Luther Sep. 1969 226 p
(Contract NAS3-9428)
(NASA-CR-72642; APS-5327-R) Avail: CFSTI CSCL 13G

The Brayton Rotating Unit with Rolling Element Bearings (BRU-R) consists of a compressor, turbine, and alternator mounted on a common shaft, supported by two 30-mm angular contact ball bearings, gas-cooled and oil-mist-lubricated within a closed-cycle system. A unique bellows face seal with a hydrodynamic gas bearing on the carbon nose isolates each bearing and prevents oil contamination of the Brayton-cycle working fluid. The bearing and seal designs were confirmed in the BRU-R during a 500-hr and 50-hr endurance test. Seal leakage into the Brayton loop during the test was less than the 0.07 lb of oil specified for a 500-hr operation. Author

N70-24723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EVALUATION OF INTEGRAL COVERS ON SILICON SOLAR CELLS

John W. Fairbanks Sep. 1969 28 p refs

(NASA-TM-X-63875; X-716-69-383) Avail: CFSTI CSCL 10B

The integrally coverslipped solar cell which promises significant cost reduction and power-to-weight ratio improvement for space power systems is studied. The initial approach involved fusing a borosilicate glass on the cell surface. In the other approaches, two types of sputtering were developed: Radio Frequency (RF) sputtering and high-vacuum-ion-beam sputtering. Sputtering work was concentrated on fused silica. Cells coverslipped by these three techniques were subjected to solderability, temperature-humidity, and radiation tests. All cells were solderable by conventional techniques. Several RF sputtered coverslipped cells fractured during temperature-humidity testing. Cells with 2 mil sputtered coverslips were protected from 500 keV and 2.0 MeV protons at fluences to 10 to the 14th power protons/sq cm. Bare cells with CeO2 and SiO anti-reflection coatings exposed to the same proton exposures were equally degraded. Author

N70-24832# Gesellschaft fuer Weltraumforschung m.b.H., Bad Godesberg (West Germany).

SPACE EXPERIMENT POWER SUPPLIES

F. W. Kraemer *In* Univ. Coll., London Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 51–54 refs (See N70-24826 11-30)

Avail: CFSTI

The general design requirements of satellite power supplies, with particular reference to converter design is considered. It is assumed that the spacecraft includes a primary power source(e.g. solar cells and storage batteries), and the necessary power conditioning and control subsystem, in order to provide an unregulated DC supply at the interface between the spacecraft and the experiment. The experiment package itself incorporates a converter (or converters) to produce the voltage levels required by the individual units of the instrument. Author (ESRO)

N70-25053# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE QUESTION OF DETERMINING THERMODYNAMICALLY OPTIMUM PARAMETERS IN REGENERATIVE THERMOPOWER CYCLES OF LOW-BOILING SUBSTANCES

G. P. Verkhivker et al 3 Oct. 1969 21 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Energ. (Minsk), v. 8, no. 1, 1965 p 46–53

(AD-699231; FTD-MT-24-241-69) Avail: CFSTI CSCL 10/1

This article discusses the method of determining thermodynamically optimum parameters of cycles of low-boiling substances. The most promising low-boiling substance is carbon dioxide. Three cycles of the low-boiling substance have been proposed: a gas cycle, a cycle with liquid compression and a compound cycle. At the initial and final temperatures of the cycle, the basic thermodynamic parameter of the scheme determining its economy is the degree of increase in pressure. The selection of temperature difference in heat exchangers and losses in pressure represents a technical and economic problem not examined in this article. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-23997# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.

APPLICATION OF OPTIMIZATION PRINCIPLES IN DETERMINING THE INTERNAL MOMENTS IN HUMAN LEG JOINTS DURING GAIT Technical Report

K. Rim and E. Y. Chao Nov. 1969 46 p refs

(Contract DA-ARO(D)-31-124-G997)

(AD-699385; TR-1) Avail: CFSTI CSCL 6/3

To eliminate the difficulties encountered in numerical differentiation in calculating the internal moments at leg joints during gait, an alternative method based on optimal design principles is proposed. In this method, the moments are first estimated in order to solve a set of differential equations for the velocities and displacements involved during gait. The displacements so obtained are compared with the experimentally measured values. An iterative scheme is developed so that as the variations between the calculated and the measured displacements decreases the desired solution for the moments is approached. The analytical model of human gait is derived based on reasonable assumptions. The direct method of steepest descent is applied to pursue the solution. The existence and uniqueness of the solution are discussed based on the characteristics of the physical system and the method of steepest descent. The analysis and the method of solution can easily be extended to other similar biodynamical problems. TAB

N70-24161# Syracuse Univ., N.Y. Dept. of Electrical Engineering.

ATRIAL AND VENTRICULAR FIBRILLATION AS THE EFFECT OF A NOISE REDUCING SYSTEM Technical Report

Stanford Goldman 12 Dec. 1969 18 p refs

(Contract N00014-67-A-0378-0002)

(AD-699190; EE-1607-69-12T2; TR-2) Avail: CFSTI CSCL 6/16

It is pointed out that noise reducing systems ordinarily operate to reduce noise only so long as the noise magnitude does not exceed a certain threshold. When this threshold is exceeded, the noise tends to eliminate the desired signal. The theory of atrial and ventricular fibrillation is then reviewed. This is done with the aid of simplified highly diagrammatic figures. The perturbations in the wavefront of depolarization due to such causes as hypoxia are identified with noise. It is pointed out that the cross connections in the Purkinje system and in the syncytial tissue both act to decrease the magnitude of the noise. It is also pointed out that when the noise is sufficiently large, it acts through the same cross connections to eliminate the desired signal, namely the normal heart beat. This amounts to a description of fibrillation in the language of noise reduction threshold theory. Thus fibrillation may be considered the result of a noise reduction system which is thrown into a pathological type of operation because the noise level has exceeded threshold. Author (TAB)

N70-24199# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEDICAL-BIOLOGICAL STUDIES IN WEIGHTLESSNESS, PART 1

V. V. Parin et al 22 Aug. 1969 331 p refs Transl. into ENGLISH of the book "Mediko-Biologicheskiye Issledovaniya v Nevesomosti" Moscow, Meditsina, 1968 p 1–464

(AD-699221; FTD-HT-23-1457-68-Pt-1) Avail: CFSTI CSCL 6/19

An evaluation of experimental data derived from manned flights and flights with animals in various types of space vehicles in the earths atmosphere. Particular attention has been devoted to evaluation of tests conducted during the manned Soviet Vostok and Voskhod flights, and of the results obtained on human performance under conditions of weightlessness. Author (TAB)

N70-24200# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEDICAL BIOLOGICAL STUDIES IN WEIGHTLESSNESS, PART 2

V. V. Parin et al 22 Aug. 1969 233 p refs Transl. into ENGLISH of the book "Mediko-Biologicheskiye Issledovaniya v. Nevesomosti" Moscow, Meditsina, 1968 p 1–464
(AD-699226; FTD-HT-23-1457-68-Pt-2) Avail: CFSTI CSCL 6/19

For abstract see N70-24199.

N70-24222*# Naval Aerospace Medical Inst., Pensacola, Fla. Bureau of Medicine and Surgery.
EXPOSURE OF ESCHERICHIA COLI TO LOW-FREQUENCY VIBRATIONS
Dietrich E. Beischer and Glenda S. Cowart 15 Jan. 1970 12 p refs
(NASA Order W-12766)
(NASA-CR-109494; NAMI-1096) Avail: CFSTI CSCL 06C

The assumption is made that low frequency vibration as experienced in air and space vehicles may increase the genetic load. This hypothesis was tested by studying the effects of vibration on the formation of biochemical mutants in Escherichia coli. No significant differences from unvibrated controls were observed either in growth or in number and kind of nutritionally dependent cells arising in E. coli vibrated at frequencies from 20 to 100 Hz. Exposure times varied from 5 to 60 minutes, and accelerations from 5 to 20 G. The experiments demonstrate that the single linkage chromosome structure of the protokaryotic E. Coli is mechanically stable enough to withstand the mechanical forces of vibration within the limits used. Author

N70-24258# Bellarmine-Ursuline Coll., Louisville, Ky.
THE RELATIONSHIP BETWEEN SUBJECTIVE AND OBJECTIVE ASSESSMENT OF FATIGUE Annual Progress Report, 1 Oct. 1968 –30 Sep. 1969
Joseph H. Voor 30 Oct. 1969 15 p refs
(Contract DADA17-68-C-8042)
(AD-699370; BUC-2; APR-2) Avail: CFSTI CSCL 6/16

The reliability of the relationship between subjective and electromyographic assessment of fatigue in an isometric muscle contraction task was established under conditions of competition, monetary reward, and over a series of trials for both male and female Ss. Studies are now under way, or planned, to determine the effects of (a) anxiety, (b) the time at which motivation is introduced, (c) training of the S, and (d) personality variables upon the assessment of fatigue and the efficiency of the performance of the Ss. Author (TAB)

N70-24308*# Naval Aerospace Medical Inst., Pensacola, Fla.
EVALUATION OF ANTIMOTION SICKNESS DRUGS: A NEW EFFECTIVE REMEDY REVEALED
Charles D. Wood and Ashton Graybiel Mar. 1970 9 p refs
(NASA Order R-93)
(NASA-CR-109500) Avail: CFSTI CSCL 06O

Three single drugs (one used in three dosage levels) and three drug combinations were compared in their effectiveness to prevent motion sickness under standardized stress conditions in a slow rotation room. An unexpected finding was that a combination of promethazine 25 mg with d-amphetamine 10 mg had the same range of effectiveness as that found in earlier studies (and confirmed here) for scopolamine 0.6 mg plus d-amphetamine 10 mg. When scopolamine was tested alone, halving the "usual" dose (0.6 mg) reduced its effectiveness about one-fifth and doubling the usual dose increased effectiveness by 29 per cent; thus, the optimum dose of scopolamine appeared to be approximately 0.5 mg. Betahistine hydrochloride (4 mg) was ineffective and cinnarizine (50 mg) was of small benefit. Author

N70-24322# Aztec School of Languages, inc., Maynard, Mass.
THEORY OF NEURAL EXCITATION AS COOPERATIVE CATION EXCHANGE IN A TWO-DIMENSIONAL LATTICE. PART 1: THE ION CURRENT AFTER A DEPOLARIZING JUMP IN THE MEMBRANE POTENTIAL [THEORIE DES NERVENERREGUNG ALS KOOPERATIVER KATIONEN-AUSTAUSCH IN EINEM ZWEIDIMENSIONALEN GITTER. I. IONENSTROM NACH EINEM DEPOLARISIERENDEN SPRUNG IM MEMBRANPOTENTIAL]
Gerold Adam Nov. 1969 49 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 23b, 1968 p 181–197 Prepared for Lincoln Lab., MIT
(AZT-69-626-Gell) Avail: CFSTI

The presently accepted theory of nerve excitation fails to explain the mechanism of regulation of the state of the axon membrane by the membrane potential or the cation activities. A physicochemical mechanism is proposed for the regulation of the excitation state based on a model of the axon membrane as a two dimensional cooperative cation exchanger in contact with the electrolyte reservoirs inside and outside. In the resting state, the lattice units of the cation exchanger bind calcium ions. Upon depolarization or decrease of the calcium activity in the outside medium, the resting state becomes unstable and univalent cations are bound by the lattice units. The ion movements accompanying the cation exchange give rise to the inward excitation current, as observed in a voltage clamp experiment. This cooperative cation-exchange can be considered as a two dimensional phase transition. Its kinetics are described by the processes of nucleation and nucleus-growth. The theory in good agreement with experiment described the dependence of the ion current on time and on membrane potential for small depolarizations. Author

N70-24424*# California Univ., Berkeley. Dept. of Nutritional Sciences.
INTEGRATED RESEARCH PROGRAM IN SPACE NUTRITION Semiannual Report, 1 Aug. 1969 –31 Jan. 1970
Doris Howes Calloway and Sheldon Margen Feb. 1970 20 p refs
(Grant NGR-05-003-351)
(NASA-CR-109490) Avail: CFSTI CSCL 06P

An experiment to prove that increasing dietary protein intake raises urinary uric acid excretion in humans is reviewed. A direct relationship between dietary protein intake and uric acid excretion was shown for strictly purine-free, formula diets containing up to 96 g nitrogen per day. Another experiment with four men studied the effect of water diuresis associated with a high protein diet on uric acid excretion. The study indicates that elevated blood and urinary urea concentration may enhance renal uric output. A third experiment suggests that, even in the presence of a large exogenous purine load, allopurinol suppresses uric acid formation from purines synthesized endogenously. Fasting and postprandial serum amino acid patterns are given for healthy men fed formula diets containing either an adequate amount or no protein. Attempts were made to characterize the radioprotective factor in alfafa. S.S.

N70-24447*# Food and Drug Administration, Cincinnati, Ohio. Div. of Microbiology.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Oct. –31 Dec. 1969
R. B. Read, Jr. Mar. 1970 15 p
(NASA-Order R-36-015-001)
(NASA-CR-109406; QPR-19) Avail: CFSTI CSCL 06M

The results of thermal inactivation research are presented. Accomplishments reported include: (1) preliminary studies on the inactivation of B subtilis var. niger in the range of mean

concentrations of 1 million to 0.01 test organisms per sample, (2) determined the amount of water in the system when spores were exposed to heat, and (3) characterized 1247 isolates from Apollo 12. Author

N70-24595# Navy Medical Neuropsychiatric Research Unit, San Diego, Calif.
SLEEP LOSS AND ITS EFFECTS ON PERFORMANCE
Paul Naitoh Aug. 1969 75 p refs
(AD-699505; Rept-68-3) Avail: CFSTI CSCL 6/5

The effects of sleep loss on human task performance are discussed under total, partial, and selective deprivations of sleep. Some of the frequently used psychological tasks in studies of total sleep loss are described in sufficient detail so that experimenters could choose, on the basis of materials presented in this monograph, adequate tasks to fit their experimental objectives. Factors which play critical roles in determining the degree of task sensitivity to total sleep loss are listed. Effects of shortened hours of sleep on human task performance are discussed. Effects of selected sleep deprivation on performance are also commented upon. The commentary is followed by a bibliography on sleep deprivation with author and subject indices. Author (TAB)

N70-24704# Eidgenossische Technische Hochschule, Zurich (Switzerland).
STUDIES ON INTERFERENCE MICROSCOPIC MASS DETERMINATION FOR INHOMOGENEOUS OBJECTS [UNTERSUCHUNGEN ZUR INTERFERENZMIKROSKOPISCHEN MASSENBESTIMMUNG AN INHOMOGENEN OBJEKTEN]
Werner Mueller (Ph.D. Thesis) 1968 65 p refs In GERMAN
(DISS-4272) Avail: CFSTI

The photometric integration method of Davies and Deeley (1956) and Mitchison et al (1956) has been further developed. A preparation technique for interference microscopy has been studied. The determination of the parameter (referred to the refractive index of water) of fixed, dried calf thymus nuclei gave 0.155 by comparison of a gravimetric with the interference microscopical mass determination. Author

N70-24804*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
STUDIES ON THE PSYCHOPHYSIOLOGY OF THE WORK OF ASTRONAUTS
N. N. Gurovskiy, ed. Washington NASA Mar. 1970 144 p refs Transl. into ENGLISH of the Book "Ocherki Psikhofiziologii Truda Kosmonavtov" Moscow, Meditsina Press, 1967 p 1-140
(Contract NASw-1692)
(NASA-TT-F-593) Avail: CFSTI CSCL 05J

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3. THE RATIONAL DESIGN OF A REGIMEN OF WORK FOR ASTRONAUTS F. P. Kosmolinskiy et al p 25-31 refs (See N70-24807 11-04)

4. SENSORY DEPRIVATION IN SPACE FLIGHT F. P. Kosmolinskiy et al p 32-48 refs (See N70-24808 11-04)

5. INFLUENCES ON THE HUMAN ORGANISM OF ALTERED AFFERENTATION F. P. Kosmolinskiy p 49-57 refs (See N70-24809 11-04)

6. PRINCIPLES AND MEANS OF INVESTIGATION OF PROBLEMS OF DAYS IN SPACE B. S. Alyakrinskiy p 58-64 refs (See N70-24810 11-04)

7. THE INFLUENCE OF VARIOUS REGIMENS OF WORK AND REST ON THE FUNCTIONAL CONDITION OF A MAN DURING A LONG STAY IN A HERMETICALLY SEALED CHAMBER A. A. Veselova et al p 65-90 refs (See N70-24811 11-04)

8. THE INFLUENCE OF A CHANGE IN REGIMEN OF THE DAILY ACTIVITY ON THE HUMAN ORGANISM UNDER CONDITIONS OF ISOLATION V. I. Mayasnikov p 91-105 refs (See N70-24812 11-04)

9. THE CAPACITY FOR WORK AND THE CONDITION OF HIGHER NERVOUS ACTIVITY UNDER VARIOUS LIFE REGIMENS M. A. Gerd p 106-115 refs (See N70-24813 11-04)

10. DYNAMICS OF THE INTELLECTUAL CAPACITY FOR WORK AND THE CONDITIONS OF HYPODYNAMIA, ISOLATION, AND ELEVATED TEMPERATURE IN A HERMETICALLY SEALED CHAMBER Y. M. Krutova p 116-124 refs (See N70-24814 11-04)

11. SIGNIFICANCE OF MUSCULAR ACTIVITY FOR THE PRESERVATION OF STABILITY OF AN ASTRONAUT'S MOTOR FUNCTIONS A. V. Korobkov et al p 125-134 refs (See N70-24815 11-04)

12. INVESTIGATIONS OF HUMAN MOTOR FUNCTIONS UNDER THE CONDITIONS OF AN ALTERED DAILY REGIMEN V. M. Devishvili et al p 135-140 refs (See N70-24816 11-04)

N70-24805*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
SEVERAL PECULARITIES IN WORK ACTIVITY OF ASTRONAUTS ON PROLONGED SPACE FLIGHT
N. N. Gurovskiy *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 1-8 (see N70-24804 11-04)
Avail: CFSTI CSCL 05J

The work regiman defines the structure of life during a prolonged space flight. Specifications must be developed for the precise regulation of the work process of the astronauts. Author

N70-24806*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE PHYSIOLOGICAL BASIS OF HUMAN ADAPTATION TO SPECIFIC CONDITIONS OF ACTIVITY
S. A. Kosilov et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 9-24 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

Under the conditions of a space flight, the work and rest regimen must be grounded, taking into account the necessity of a gradual but significant restructuring of the astronaut's physiological functions. Specific conditions of the astronaut's activities must be determined in order to overcome the difficulties produced by the environment and to design a satisfactory program for work activity. Author

N70-24807*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE RATIONAL DESIGN OF A REGIMEN OF WORK FOR ASTRONAUTS
F. P. Kosmolinskiy et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 25-31 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

Experiments have evidenced the changes in bodily and mental functions which result from the unique environment peculiar to space flights. Methods of organizing the astronaut's work and rest regimen to compensate for and/or avoid these changes are proposed. Author

N70-24808*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
SENSORY DEPRIVATION IN SPACE FLIGHT

F. P. Kosmolinskiy et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 32–48 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 06S

The effects of a lack of external stimuli and motor activity during prolonged space flights are discussed. Experiments show that isolation and sensory deprivation create complex physiological and psychological reactions in the human organism. Author

N70-24809*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INFLUENCES ON THE HUMAN ORGANISM OF ALTERED AFFERENTATION
F. P. Kosmolinskiy *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 49–57 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 06S

Among the factors acting on the astronaut during prolonged space flights, variations between sensory understressing and sensory overstressing have the greatest significance. An informational overload is shown to affect the organism as detrimentally as the opposite phenomenon (sensory deprivation). Several solutions to the problem of overcoming these difficulties are discussed, including total organization and control of the interior arrangement of the spaceship, ordering of work and rest regimen for the crew, and preflight training. Author

N70-24810*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
PRINCIPLES AND MEANS OF INVESTIGATION OF PROBLEMS OF DAYS IN SPACE
B. S. Alyakrinskiy *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 58–64 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 06P

The various factors influencing the possible organizations of daily periodicity under space flight conditions are discussed. Suggestions are made as to need for further investigations relating to the organization of the space day. Author

N70-24811*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE INFLUENCE OF VARIOUS REGIMENS OF WORK AND REST ON THE FUNCTIONAL CONDITION OF A MAN DURING A LONG STAY IN A HERMETICALLY SEALED CHAMBER
A. A. Veselova et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 65–90 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 06S

Two experiments were conducted in which subjects were placed in a hermetically sealed chamber and their reactions were studied. As a result, the specific effects of these unusual environmental conditions and of an unaccustomed regimen of work and rest were able to be pinpointed. Author

N70-24812*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE INFLUENCE OF A CHANGE IN REGIMEN OF THE DAILY ACTIVITY ON THE HUMAN ORGANISM UNDER CONDITIONS OF ISOLATION
V. I. Myasnikov *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 91–105 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

A number of experiments were conducted in which men were isolated in a soundproof chamber for extended periods of time. The regimens of work and rest which the subjects followed were varied. The results of these investigations, particularly the psychophysical effects on the organism, are presented. Author

N70-24813*# Aztec School of Languages, Inc., Maynard, Mass.
THE CAPACITY FOR WORK AND THE CONDITION OF HIGHER NERVOUS ACTIVITY UNDER VARIOUS LIFE REGIMENS
M. A. Gerd *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 106–115 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

The results of various tests of mental and physical reflexes during a two-week experiment with three subjects are presented. Round-the-clock watches were established and results are given presenting comparisons of responses of subjects according to the shifts worked. Author

N70-24814*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
DYNAMICS OF THE INTELLECTUAL CAPACITY FOR WORK AND THE CONDITIONS OF HYPODYNAMIA, ISOLATION, AND ELEVATED TEMPERATURE IN A HERMETICALLY SEALED CHAMBER
Y. M. Krutova *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 116–124 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

Three experiments on isolation effects in a hermetically sealed chamber on memory and metal concentration are discussed. Author

N70-24815*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
SIGNIFICANCE OF MUSCULAR ACTIVITY FOR THE PRESERVATION OF STABILITY OF AN ASTRONAUT'S MOTOR FUNCTIONS
A. V. Korobkov et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 125–134 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 05J

The psychological and physiological effect of weightlessness, limited mobility, and hypoxia are examined. The use of exercise as a means of prophylaxis of these effects is discussed. Author

N70-24816*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INVESTIGATIONS OF HUMAN MOTOR FUNCTIONS UNDER THE CONDITIONS OF AN ALTERED DAILY REGIMEN
V. M. Devishvili et al *In its* Studies on the Psychophysiol. of the Work of Astronauts Mar. 1970 p 135–140 refs (See N70-24804 11-04)
Avail: CFSTI CSCL 06S

Investigations of the effects of an altered daily regime upon muscular strength and endurance are reported. Author

N70-24919# Joint Publications Research Service, Washington D.C.
MYSTERIOUS BEHAVIOR OF DOLPHINS
A. Tomilin 30 Mar. 1970 8 p ref Transl. into ENGLISH from Sots. Industriya (Moscow), 25 Jan. 1970 4 p
(JPRS-50182) Avail: CFSTI

Physical and behavioral patterns and characteristics of dolphins are described in terms of their application in signal and information transmission, rapid and safe submergence, and construction of

sensitive and portable hydrolocator. Use of the skin of dolphins as a model for the outer coatings of high speed ships and the domestication and practical utilization of dolphins in fishing and sea investigations are also discussed. S.S.

N70-25057# Eidgenossische Technische Hochshule, Zurich (Switzerland).
ON THE VITRIFICATION OF DILUTED AQUEOUS SOLUTIONS [UEBER DIE VITRIFIZIERUNG VERDUENNTER WAESSRIGER LOESUNGEN]
Udo Riehle (Ph.D. Thesis) 1968 133 p refs In GERMAN
Its Diss. No. 4271
Avail: CFSTI

The normally encountered formation of ice crystals of 1 to 10 millimicron in size destroys the fine structure and viability of frozen cell materials. As the cooling rate is increased, the crystal size is found to decrease approximately in proportion. When a critical value is reached, the crystal size suddenly reduces to 50 to 100 AU. By optimizing the heat transfer and freezing under a hydrostatic pressure load, the so-called "vitreous state" with a particle size of 50 to 100 AU was obtained for the first time in a 5% by weight glycerol-water solution. Additional experiments with some other substances and good agreement of the observed effects with the theoretical approach suggest that all biological materials exhibit a critical cooling rate and many thus be vitrified in samples of a few hundred millimicron in thickness. Author

N70-25084# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
ENVIRONMENTAL RADIOACTIVITY, ISPRA 1968
M. de Bortoli and P. Gaglione 1970 60 p refs
(EUR-4412.E) Avail: CFSTI

The measurements of environmental radioactivity performed during 1968 by the site survey group of the Protection Service are described. Data are given on the concentrations of strontium-90, cesium-137 and other radionuclides in fallout, air, soil, waters, herbage, animal bones and foods. Author

N70-25127*# Naval Aerospace Medical Inst., Pensacola, Fla.
A STANDARDIZED LABORATORY MEANS OF DETERMINING SUSCEPTIBILITY TO CORIOLIS (MOTION) SICKNESS
Earl F. Miller, II and Ashton Graybiel 7 Feb. 1969 31 p refs
(NASA Order R-93; NASA Order T-81633)
(NASA-CR-109425; NAMI-1058) Avail: CFSTI CSCL 06S

With the method described, the subject is required to move his head within a standardized time and space pattern while the chair rotates at an individually preselected constant velocity. Such movements evoked the common endpoint of severe malaise (M III) in 98.8 per cent of the 250 normal subjects. Susceptibility was scaled by the magnitude of the stressor stimulus and scored (Coriolis Sickness Susceptibility Index, CSSI) as the number of head movements executed at a given chair velocity in reaching the test endpoint, multiplied by the stressor effect (E factor) of each head movement as previously determined for each chair velocity. In most cases the test velocity that evoked M III within the set limits of 40 and 166 head movements could be predicted on the basis of the subject's past history of motion sickness. The frequency distribution of CSSI values of the normal subjects was markedly right skewed on an arbitrary scale of 0 to 100 points; 90 per cent fell within 0.4 and 26.0 points. At the M III level, mild nausea, epigastric awareness, or discomfort was manifested by the majority of the group, but 9.6 per cent reached this level completely free of these symptoms. High reliability, simplicity, minimal time, conventional apparatus, and quantitative scaling of susceptibility are advantages of this new standardized test. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-24036# Michigan Univ., Ann Arbor. Computer and Communication Sciences Dept.
COMPUTER SIMULATION OF A LIVING CELL: MULTILEVEL CONTROL SYSTEMS
Roger Weinberg and Bernard P. Zeigler Dec. 1969 48 p refs
(Contracts N00014-67-A-0181; DA-31-124-ARO(D)-483; Grant NIH GM-12236)
(AD-699380; Rept-08226-17-T) Avail: CFSTI CSCL 6/4

A simple bacterial cell (Escherichia coli) has been modeled, and the input-output behavior of the model has been simulated as a program in FORTRAN IV for an IBM 360/67 digital computer. Automata theoretic analysis of the homomorphic model underlying the computer simulation enables us to investigate the information content and complexity of the simulation and of the measurement space representing our data base. The simulated cell is able to adjust its enzymes and DNA to grow in different chemical environments using allosteric modification of enzymes, and repression of RNA synthesis. It grows at realistic rates and achieves limited metabolic stability. Author (TAB)

N70-24048# Human Factors Research Inc., Goleta, Calif.
GEOGRAPHIC ORIENTATION IN AIRCRAFT PILOTS: AN ANALYTICAL STUDY OF VISUAL CHECKPOINTS Technical Report
James J. Mc Grath and Gail J. Borden Jun. 1969 224 p refs
(Contract Nonr-4218(00))
(AD-698266; TR-751-9; JANAIR-690614) Avail: CFSTI CSCL 5/5

A major study of the use of visual checkpoints in low-altitude navigation was conducted. The purpose was to develop a method for deriving design criteria for aeronautical charts, particularly those criteria used to select features for portrayal on the charts. Potential checkpoints visible in motion pictures taken at low altitude were cataloged in detail. Each feature was classified according to its category, measured according to its visual parameters (size, shape, contrast, etc.), and coded according to whether or not it was portrayed on standard aeronautical charts. The report presents a large amount of data showing the pilots ability to interpret charts, the cartographers ability to select the best features for portrayal, the categorical and parametric criteria that define the most useful checkpoints, and the effects of low-altitude experience on the pilots evaluations of checkpoints. Author (TAB)

N70-24054# Human Resources Research Organization, Alexandria, Va.
THE EFFECTS OF INTERRUPTION OF DARK ADAPTATION ON PERFORMANCE OF TWO MILITARY TASKS AT NIGHT Technical Report
David L. Easley, Donald L. Wright, William N. Warnick, and William N. Gipe Dec. 1969 49 p refs
(Contract DAHC19-70-C-0012)
(AD-699489; HUMRRO-TR-69-20) Avail: CFSTI CSCL 6/16

To determine how interruption of dark adaptation (by using an intensifier) affected performance of military tasks with unaided vision at night, two series of studies were conducted. In one series, subjects walked parallel to a guideline, keeping as far as possible to the right; in the other series, subjects fired the M14 rifle at silhouette targets. Interruption of dark adaptation with a simulated monocular intensifier in the shooting eye or both eyes just before the task was begun affected the horizontal distance at which the guideline was followed. A readaptation interval of two to three

minutes after interruption of dark adaptation by a binocular intensifier was related to performance under dark-adapted vision. Author (TAB)

N70-24086# Information Resources, Inc., Cambridge, Mass.
INFORMATION MAPPING FOR LEARNING AND REFERENCE Final Report, May 1968 –Jul. 1969
Robert E. Horn, Elizabeth H. Nicol, Joel C. Kleinman, and Michael G. Grace Bedford, Mass. ESD Aug. 1969 141 p refs
(Contract F19628-68-C-0212)
(AD-699201; ESD-TR-69-296) Avail: CFSTI CSCL 5/9

Information mapping is a method of organizing categories of information and of displaying them for both learning and reference purposes. The method may be applied to the production of self-instructional books or to the organization of data bases for computer-aided instruction and reference. The report is itself written in modified information map form. The procedures and rules for information mapping were derived from educational research and technology as well as from the communications world. Preliminary work with simulated computer displays has explored the flexibility with which a system so organized can respond with a range of user options and display variations. Cost per instruction hour is competitive with that of other methods, but the method has additional advantages in its versatility and ease of updating. Author (TAB)

N70-24078# Edinburgh Univ. (Scotland). Dept. of Machine Intelligence and Perception.
EXPERIMENTAL PROGRAMMING, 1968 –1969
Jun. 1969 83 p refs
(Grant SRC B/SR/3811)

Development and initial experiments with the adaptive graph traverser and a simulated automaton are described, along with the experimental programming. The graph traverser is a heuristic problem solving program for finding a path across a problem graph whose nodes are representations of the problem states and whose connecting arcs represent the application of operators to the states. Experiments solved by the graph traverser, such as the traveling salesman problem and moving a knight around a chessboard so that he lands on every square, are described. The development of a hardware automaton designed and to equip the computing system with a sufficient array of sensory and motor faculties to carry out a mapping exercise in a simulated forest is discussed, along with the mapping and more advanced tasks. The relevance of deductive retrieval to the design of intelligent automata is summarized. N.E.N.

N70-24125# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
EFFECTS OF TWO COMMON MEDICATIONS ON COMPLEX PERFORMANCE
W. Dean Chiles, Harry L. Gibbons, and Paul W. Smith Jun. 1969 5 p *ref*
(FAA-AM-69-9) Avail: CFSTI

The performance of 10 subjects was measured over 4-hour periods following the administration of normal clinical dosages of Donnatal (two sessions), chlorpheniramine maleate (one session) and a placebo (one session) in a double blind experiment. Prior to the experiment, the subjects were given extensive training on the battery of tasks used. The subjects were tested as two 5-man crews on the tasks which were designed to assess psychological functions of the kind involved in aircraft operations; included were measures of monitoring, information processing, visual discrimination and "crew coordination." Although performance was in general "numerically" inferior under the chlorpheniramine maleate condition, no effects were found that could be statistically attributed to the drugs administered. Author

N70-24126# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
METHODOLOGY IN THE ASSESSMENT OF COMPLEX PERFORMANCE: THE EFFECTS OF SIGNAL RATE ON MONITORING A STATIC PROCESS
W. Dean Chiles, Cherly B. Bruni, and Robert A. Lewis Aug. 1969 11 p refs
(FAA-AM-69-16) Avail: CFSTI

This study concerned the rate of presentation of stimuli on a task involving the monitoring of a static process of the kind represented by aircraft warning light indicators. The task was performed concurrently with various combinations of tasks requiring the exercise of psychological functions representative of the demands placed on the human operator in aviation operations. The signal rates used were: 10.3 signals/hour, 17 signals/hour, and 22.5 signals/hour. The only task for which performance varied significantly across the three rates of signal presentation was the task requiring the monitoring of a dynamic process; performance of this task was facilitated by the highest rate of signal presentation on the static monitoring task. The two faster rates of signal presentation were found to yield more reliable measures of static monitoring performance than the lower rate. Author

N70-24139# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Human Resources Lab.
A SYSTEMS APPROACH TO ELECTRONICS MAINTENANCE TRAINING
Horce H. Valverde 1969 17 p refs Presented at the IEEE and ERS Intern. Symp. on Man-Machine Systems, Cambridge, England, 8-12 Sep. 1969
(AD-698752) Avail: CFSTI CSCL 5/9

The document describes the development and evaluation of an Air Force systems-oriented electronics maintenance course for weapon control systems technicians. The program consisted of three phases: A behavioral description based upon a task analysis of actual job requirements. An experimental 14-week training course prepared from the objectives obtained in Phase 1. A group of subjects with electronics aptitude percentile scores ranging from 60 to 95 received training. Data on all subjects was obtained including aptitude scores, reading ability scores, course grades, end-of-course performance testing, field followup performance testing and supervisory appraisals. The performance of experimental and control groups was compared on the basis of these data. Author (TAB)

N70-24177# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
COMPLEX PERFORMANCE DURING EXPOSURE TO HIGH TEMPERATURES
P. F. Iampietro, W. D. Chiles, E. A. Higgins, H. L. Gibbons, A. Jennings et al Jun. 1969 18 p refs
(FAA-AM-69-10) Avail: CFSTI

The effects of high temperature on psychomotor performance and physiological function were studied on male pilots (age 30–51 holding a current medical certificate. A total of 41 runs were made at neutral (23.8 C. (75 F.), or hot (60.0 C. (140 F.), 71.1 C. (160 F.)) temperatures with low humidities (less than 20 mm. Hg at 60.0 and 71.1 C.). Heart rate (ECG), deep body temperature (rectal probe) and skin temperature were recorded at 2-minute intervals. Performance on a complex performance device (two-dimensional tracking, mental arithmetic, and monitoring) was scored for 5-minute intervals which varied in task difficulty. During exposure to 71.1 C. mean rectal temperature reached 38.05 C. (100.5 F.), mean peak heart rate was 132 beats/min., and mean finger temperature peaked at 42 C. (107.6 F.). There were significant decrements in performance (tracking and mental arithmetic) at 71.1 C. At 60 C. there were no performance decrements during 30 minutes of exposure. Results are discussed as they apply to aircrew in high performance aircraft. Author

N70-24190# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMIZATION OF RECOGNITION SYSTEM TRAINING
T. Gergely et al 7 Aug. 1969 15 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 6, 1967 p 14–22
(AD-699224; FTD-HT-23-139-69) Avail: CFSTI CSCL 6/4

Several schemes are investigated for training pattern-recognition systems. A method is presented for analyzing the process of training a linear perceptron by means of oriented graphs. A statistical model is also introduced which permits one to minimize the length of the training sequence of a recognition system by means of series analysis. TAB

N70-24204# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
THE SPIRAL AFTEREFFECT. PART 2: SOME INFLUENCES OF VISUAL ANGLE AND RETINAL SPEED ON THE DURATION AND INTENSITY OF ILLUSORY MOTION
Mary Jane Williams and William E. Collins Aug. 1969 12 p refs
(FAA-AM-69-15) Avail: CFSTI

The spiral aftereffect (SAE) is an example of one type of visual illusion-that which occurs following the cessation of real motion. Duration and intensity of the SAE was evaluated under five conditions: visual angle constant with retinal speed also constant; stimulus size constant-the same size spiral was set at a variety of distances (and visual angles) with retinal speed either varying or held constant; distance constant-several spiral sizes (visual angles) were used at a constant distance with retinal speed either varying or held constant. Results indicate that perceived (rather than physical) characteristics of the stimulus situation may have the most significant effects on duration of the SAE. The findings thus have considerable pertinence to the evaluation of effective factors in the production of a variety of other visual illusions which can occur in aviation environments. Author

N70-24206# Pittsburgh Univ., Pa. Learning Research and Development Center.
APPROACHES TO THE VALIDATION OF LEARNING HIERARCHIES Technical Report
Lauren B. Resnick and Margaret C. Wang Aug. 1969 41 p refs *Its* Preprint-50
(Contract Nonr-624(18))
(AD-699211) Avail: CFSTI CSCL 5/10

The paper describes a program of research in the application of scalogram analysis to the validation of learning hierarchies, together with the development of an alternative method for assessing hierarchical relationships among tests of instructional objectives. The relationship between scalability of tests and positive transfer between objectives in the course of learning is discussed and experimental transfer studies testing hierarchical hypotheses are described. Related research by developmental and learning psychologists and by test designers is discussed along with the authors own research. Author (TAB)

N70-24208# Naval Personnel Research Activity, San Diego, Calif. Navy Training Research Lab.
RETENTION OF ELECTRONIC FUNDAMENTALS: DIFFERENCES AMONG TOPICS Final Report
Kirk A. Johnson Aug. 1969 32 p refs
(AD-699156; NPRA-STB-70-1) Avail: CFSTI CSCL 5/9

The purpose of the investigation was to explore some of the benefits and problems associated with the use of criterion-referenced tests in an operational training situation. The study was based on the material being taught in the first phase of an avionics fundamentals course, class A. All materials were originally taught by means of programmed instructional booklets. Author (TAB)

N70-24298* Sierra Engineering Co., Sierra Madre, Calif.
[EMERGENCY OXYGEN MASK ASSEMBLIES] Final Report
Leo F. Hotz 16 Mar. 1970 4 p
(Contract NAS9-8776)
(NASA-CR-108341) Avail: CFSTI CSCL 06K

Techniques for modifying emergency oxygen masks are discussed. Problems concerning production of the modified mask are presented. The use of viton as a replacement material for silicone is described. Viton offers a higher degree of flame resistance, but other disadvantages such as cost, weight, and stiffness have caused its use to be discontinued. Other suitable materials are required in order to continue the development effort. PNF

N70-24299*# Public Health Service Hospital, Baltimore, Md.
THE EFFECT OF PROLONGED SIMULATED NON GRAVITATIONAL ENVIRONMENT ON MINERAL BALANCE IN THE ADULT MALE, VOLUME 3, EXHIBIT A Final Report
[1968] 98 p refs
(NASA Order T-58941)
(NASA-CR-108337) Avail: CFSTI CSCL 06S

The psychological aspects of prolonged bed rest are reported as part of an overall study to determine the metabolic effects of simulated nongravitational environment over extensive time periods. The study involved three subjects being subjected to a 36 week period of continuous bed rest. The subjects selected were male, young, in good physical health, and possessing the same basic qualifications as required of astronauts. Since the primary goal of the study was metabolic in nature, there were no direct attempts to do psychologic research and the role of the psychologic team was that of enabling the subjects and staff to complete the study. The purpose of psychologic testing during the study was to evaluate any possible change in the subjects' emotional health so that corrective action could be taken if necessary. A synopsis of each weekly meeting, involving the subjects, psychologic team, and hospital staff, is presented. Results of psychologic tests given the subjects prior to, during, and at the completion of the study are included. D.L.G.

N70-24307*# Public Health Service, San Francisco, Calif. Nuclear Medicine Service.
A STUDY OF BONE MINERAL CONTENT PERFORMED BY THE GAMMA RAY ABSORPTION TECHNIQUE IN PROLONGED BED REST SUBJECTS MAINTAINED IN A METABOLICALLY CONTROLLED ENVIRONMENT: THE ULTIMATE APPLICATION OF GAMMA RAY ABSORPTION TECHNIQUES TO IN-FLIGHT BONE MINERAL MEASUREMENTS, EXHIBIT B Terminal Report
John Max Vogel [1969] 86 p refs
(NASA Order T-58941-G)
(NASA-CR-108316) Avail: CFSTI CSCL 06S

Results of a study to measure the bone mineral changes which occurred in three subjects during and after a nine month period of bed rest are presented. A decision was made to study the left os calcis on all subjects by means of a monoenergetic photon source technique. It was necessary to devise a method whereby the bed-ridden subject could have his os calcis measured repetitively over a long period of time with acceptable reproducibility of position and accuracy of measurement. The development of the instrumentation is described along with observed changes in bone mineral. Results of the study indicate: (1) Bone mineral loss from the central os calcis during a 30 to 36 week period of bed rest is substantial. (2) Areas with the least bone mineral at the beginning of the study lost it more rapidly during bed rest and regained it more rapidly after reambulation. (3) The subject with the least bone mineral, lost the most, conversely, the one with the most, lost the least. (4) The os calcis can be placed at risk, after return to G conditions, if these mineral losses occur during a prolonged period of weightlessness. D.L.G.

N70-24310*# Franklin Inst., Philadelphia, Pa. Research Labs.
SPACE RELATED BIOLOGICAL AND INSTRUMENTATION STUDIES Annual Report, Mar. 1969 – Mar. 1970
R. J. Gibson and R. M. Goodman Mar. 1970 54 p refs
(Contract NSR-039-005-018)
(NASA-CR-109394; A-B2299-4) Avail: CFSTI CSCL 06B

Experimental and research effort has continued on high reliability, multichannel telemeters. The first four-channel fm/fm implant was completed and put through bench evaluation. Long-life two-channel units were completed and packaged. Bench results are reported. Preliminary data shows great promise for the successful development of long-life, pressure-sensing implants. Based on earlier predictions, use of piezo-junction devices for this purpose shows feasibility. Studies of implantable, ion concentration transducers were continued at a somewhat reduced effort level. Details on the formulation of a flexible, paraffin-base, encapsulating material are included. Author

N70-24360# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
THE USE OF A TRANQUILIZER (CHLORDIAZEPOXIDE) IN FLIGHT TRAINING
C. E. Melton, Jr., Marlene Hoffmann, and R. H. Delafield Jul. 1969 8 p refs
(FAA-AM-69-12) Avail: CFSTI

Eleven male subjects were given flight training according to a conventional but rigidly standardized private pilot syllabus. On half of the dual flights chlordiazepoxide was given; identical-appearing placebo capsules were given on the remaining dual flights. No treatment was given on solo flights. Differences could not be distinguished between tranquilizer and placebo with respect to the urinary excretion of catecholamines and 17-OH corticosteroids and heart rates recorded continuously in flight. Author

N70-24383# Michigan Univ., Ann Arbor. Logic of Computers Group.
SYSTEM THEORETIC ANALYSIS OF MODELS: COMPUTER SIMULATION OF A LIVING CELL Technical Report
Bernard P. Zeigler and Roger Weinberg Nov. 1969 41 p refs
(Contracts N00014-67-A-0181; DA-31-124-ARO(D)-483; Grant PHS GM-12236)
(AD-699379; Rept-08226-T-16-T) Avail: CFSTI CSCL 6/4

In modelling a natural system for computer simulation one must often reduce the complexity of the system in accord with practical considerations of computer size and length of computation time. In a model of a living cell, the formal concepts of systems theory valuable were found in this regard. In particular, the notion of homomorphism is applicable to the problem of assuring that the model preserves interesting properties of the system under study while at the same time being simpler with respect to computer implementation. TAB

N70-24449*# Southwest Research Inst., San Antonio, Tex.
SOUTHWEST RESEARCH INSTITUTE ASSISTANCE TO NASA IN BIOMEDICAL AREAS OF THE TECHNOLOGY UTILIZATION PROGRAM Final Report, 1 Feb. 1969 – 28 Feb. 1970
David F. Culclasure and Betty J. Wall 31 Mar. 1970 247 p refs
(Contract NASw-1867; SwRI Proj. 13-2538)
(NASA-CR-109404) Avail: CFSTI CSCL 06B

The transfer of applicable aerospace generated research products to the field of biomedicine is reported. Individual problems submitted to the Biomedical Applications Team are described along with statements of action taken and transfers accomplished. D.L.G.

N70-24486# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
EFFECTS OF ALCOHOL ON COMPLEX PERFORMANCE
W. Dean Chiles and Alan E. Jennings Aug. 1969 11 p refs
(FAA-AM-69-14) Avail: CFSTI

Nine subjects were tested on a battery of tasks involving monitoring two-dimensional compensatory tracking, and mental arithmetic. The subjects ingested 2.5 ml. of an alcoholic beverage per kilogram of body weight two hours before testing; mean blood alcohol at the beginning of testing was 102 mg.%. Significant workload effects were found for three of the four measures of tracking performance, for simple reaction time, and for movement time in the choice reaction time task. Significant alcohol effects were found for reaction time in choice reactions, detection times for meter signals, and for three of the four measures of tracking. There was a significant interaction between workload and alcohol in the case of one tracking measure – RMS error in the vertical dimension. Nonsignificant interactions were found between alcohol and workload for absolute error in both dimensions as well as for reaction time and movement time in the choice reaction time task. Author

N70-24481*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
EARTH-ORBITING SPACE-BASE CREW SKILLS ASSESSMENT
Robert T. Gundersen Washington Apr. 1970 78 p refs
(NASA-TM-X-1982; 5-235) Avail: CFSTI CSCL 05I

Many aspects of the crew skills required for an earth-orbiting space base are discussed. Problems associated with the design aspects are considered, and an assessment of a line-type organization is made. The problems discussed are the crew billets related to work periods, cross skills, manpower allocation, weekly crew schedules, duty cycles, and crew efficiency. Crew compartmentation and crew distribution are also discussed and analyzed. The study results, problem areas, and recommendations are presented for a nominal spacebase crew. Author

N70-24497# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THREE THEORETICAL SCHEMES OF LEARNING RECOGNITION SYSTEMS
V. A. Yakubovich 4 Aug. 1969 23 p refs Transl. into ENGLISH from the Publ. "Samonastraivayushchiyesya Sistemy. Trudy" Moscow, Nauka, 1967 p 183–191
(AD-699232; FTD-MT-24-152-69) Avail: CFSTI CSCL 6/4

A perceptron-type learning pattern recognizer function is described. A real recognizer can be described by a function f(x, u). The learning problem includes the selection of the u-parameter in such a way that the approximation is as accurate as possible; the values of s(x) are known only at given points. TAB

N70-24611 California Univ., Los Angeles.
THEORY AND APPLICATION OF REMOTE INSTRUMENTATION SYSTEMS FOR BEHAVIORAL RESEARCH
Richard Max Bird (Ph.D. Thesis) 1969 557 p
Avail: Univ. Microfilms: HC $25.20/Microfilm $7.10 Order No. 69-19491

The measurement of the output factors, and the measurement and/or control of the input factors, from remote distances while the subject is in the natural environment setting is discussed. The area of interest is traced from a historical point of view indicating how specific advances in technology facilitated related advancements in RIS techniques. A generalized system model is developed for remote instrumentation systems (RIS's) for behavioral research, with major system parameters such as operational function, physical configuration of personal unit, coding and transmission, propagation, noise, antennas, portable power sources, electronic hardware, rules and regulations of the FCC, and legal

and social considerations. Each is briefly qualitatively described and a design methodology is introduced which can be used to optimize the features in the design of a functional RIS. Dissert. Abstr.

N70-24822*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FIFTY-MAN SPACE BASE POPULATION ORGANIZATION
Georg von Tiesenhausen 31 Jan. 1970 19 p ref
(NASA-TM-X-53989) Avail: CFSTI CSCL 05H

An attempt is made to establish a baseline social and functional structure for a 50-man Space Base and to show how the requirements and activities of the personnel affect the Space Base layout. Author

N70-24951*# Hamilton Standard, Windsor Locks, Conn.
TRADE-OFF STUDY AND CONCEPTUAL DESIGNS OF REGENERATIVE ADVANCED INTEGRATED LIFE SUPPORT SYSTEMS (AILSS), FEBRUARY 1968–JANUARY 1970
Washington NASA Jan. 1970 668 p refs
(Contract NAS1-7905)
(NASA-CR-1458) Avail: CFSTI HC$10.00/MF$0.65

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15. DILUENT STUDY p 715–738 (See N70-24966 11-05)

N70-24952*# Hamilton Standard, Windsor Locks, Conn.
CONDUCT OF STUDY
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 9–64 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Presented are the pertinent factors regarding the conduct of the AILSS study. Discussed are the study approach, selection philosophy, study flow, and study method. In addition, this section contains a specification requirements summary and general discussions of special system considerations including reliability, maintainability, modularity, commonality, fire safety, and microbiology. Author

N70-24953*# Hamilton Standard, Windsor Locks, Conn.
OXYGEN AND NITROGEN STORAGE
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 65–108 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Metabolic oxygen requirements are provided by reduction of crew-produced carbon dioxide and water in the oxygen regeneration subsystem. Estimated onboard storage requirements of oxygen and nitrogen lead to the selection of high pressure (3000 psi) gaseous storage tanks manufactured of filament wound material to provide oxygen and nitrogen for cabin repressurization and cabin leakage. A single tank is used for nitrogen storage and four one-third-size tanks for oxygen storage. This form of storage demands little crew time and assures high reliability, as well as low weight and good reflexibility. The selection is further supported by the decision to provide oxygen tank redundancy and low vehicle leakage probability for a 500 day mission. G.G.

N70-24954*# Hamilton Standard, Windsor Locks, Conn.
PRESSURE AND COMPOSITION CONTROL
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 109–115 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Control of the oxygen to nitrogen ratio in the cabin atmosphere is obtained by regulating partial oxygen pressure through an O2 generation system and the cabin total pressure of 7.0 psia by a leakage makeup system. A solid electrolyte process generates the oxygen required for metabolic consumption through combined electrolysis of collected carbon dioxide and water. Cabin repressurization is triggered by a pressure-actuated warning signal that alerts the crew to take manual corrective action. This selected gas storage/pressure and control system is highly reliable and possesses inherent simplicity and flexibility. Weight is not considered since tankage valving, pressure regulators, and heat exchanger weights are included in the gas storage system evaluation. G.G.

N70-24955*# Hamilton Standard, Windsor Locks, Conn.
WATER ELECTROLYSIS
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 117–156 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

A gas circulation concept is selected for the advanced integrated life support system that uses oxygen-side gas circulation in the water electrolysis configuration. This concept has a low equivalent weight, no inherent water feed or gas collection problems, and good thermal process control. G.G.

N70-24956*# Hamilton Standard, Windsor Locks, Conn.
CO2 REMOVAL AND CONCENTRATION
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 157–205 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Candidate CO2 removal and concentration are discussed in terms of advanced integrated life support systems criteria. A steam desorbed resin concept is selected for all three systems designs considered. It provides regenerable solid absorption during cyclic use of two steam regeneration beds and delivers wet CO2 with some N2 in the desorption phase to the accumulator. The system provides high reliability, good total equivalent weight, flexibility, and volume. G.G.

N70-24957*# Hamilton Standard, Windsor Locks, Conn.
O2 GENERATION/CO2 CONTROL

In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 207-251 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Detailed requirements for oxygen generation and carbon dioxide removal and reduction are given in the system specification. In general, the requirements are to generate 15.1 pounds of oxygen per day and to remove and process 18.5 pounds of carbon dioxide per day for the nine man crew. Overboard discharge of oxygen itself or oxygen in the form of carbon dioxide or carbon monoxide is to be avoided if possible. The problem is to select the system that best meets these requirements with regard to the AILSS evaluation criteria. The solid electrolyte concept is selected for all AILSS designs, primarily on the basis of its low equivalent weight, its superior secondary criteria ratings, and because a separate water electrolysis unit is not needed. A simplified representation of this concept is shown. Author

N70-24958*# Hamilton Standard, Windsor Locks, Conn.
ATMOSPHERIC CONTAMINATION CONTROL
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 253-283 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

The atmospheric contamination control system consists of a trace gas control subsystem composed of a large sorbent bed, a catalytic oxidizer, and several small sorbent beds; a bacterial contamination control subsystem consisting of three high flow rate, 0.3 micron filters; and a particulate contamination control subsystem composed of several debris traps and roughing filters. The catalytic oxidizer is the main trace gas contaminant control device. In this way the large expendable weight penalty associated with charcoal is avoided. A small sorbent bed placed before the oxidizer prevents ammonia oxidation to toxic products, but, except for ammonia, no other contaminants are kept out of the oxidizer. Contaminants that may poison the bed, such as H_2S and the halogenated hydrocarbons, are allowed to do so; for this reason, the beds are provided with an excess amount of catalyst. Complete oxidation of all contaminants is assured, because the oxidizer is maintained at 700 F, which is high enough to oxidize 100 percent of any contaminant including methane. Another small sorbent bed is placed downstream of the oxidizer. It contains lithium carbonate and is used to remove acid gases formed in the oxidizer. Author

N70-24959*# Hamilton Standard, Windsor Locks, Conn.
THERMAL CONTROL
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 285-335 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

A detailed discussion of water separation concepts precedes the temperature and humidity control section. This discussion includes descriptions of the water separators used with the cabin heat exchangers, and other separation concepts considered for use as part of the other AILSS subsystems. Air flow for temperature and humidity control provides a significant portion of the ventilation or, more specifically, the cabin air circulation requirements. Additional ventilation fan flow requirements are derived and defined in this section. The design of the liquid heat transport circuit is based largely on the integration subsystems and internal cabin heat loads. Several assumption must be made concerning the total energy load to be dissipated and its location in the vehicle. A load range must be specified to ensure adequate performance over all anticipated operating conditions. Lastly, because of a hard definition of the vehicle or its exact loads does not exist, the selected system concept must exhibit some degree of flexibility and be capable of adapting to other than defined conditions. The choice of a power plant has a significant influence upon the liquid heat transport system design, not only from the standpoint of equipment selection but also from the standpoint of process heat availability and characteristics. Author

N70-24960*# Hamilton Standard, Windsor Locks, Conn.
WATER MANAGEMENT
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 339-424 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

The AILSS water management subsystem consists of facilities to collect and purify waste water derived from urine, washwater, and humidity condensate, and to store the resulting potable water in a sterile manner. The major water reclamation equipment selected for the AILSS mission is vapor diffusion/compression and vapor diffusion. In all designs, all waste water is processed together in a single unit. The major factors influencing the selection of the two vapor diffusion concepts were: (1) best inherant sterility; (2) low maintenance time; and (3) relatively low equivalent weight. The auxiliary equipment selected includes bacterial filters and high temperature (160 F) storage tanks to control bacterial contamination, and bladderless collection and storage tanks. The former were chosen because of their high positive effectiveness in controlling bacteria and because they do not contaminate the water. Bladderless tanks were chosen because of their high reliability and low maintainability requirements. Author

N70-24961*# Hamilton Standard, Windsor Locks, Conn.
WASTE CONTROL
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 425-472 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

An integrated vacuum decomposition concept is selected as optimal procedure for disposing waste material during long manned space flights in controlled atmospheres. The system provides the following functions: (1) it collects, treats, and stores/or disposes of all solid and liquid wastes, and collects and transfers raw urine to the water management subsystem; (2) it eliminates odors, aerosols, and existing gases; (3) it sterilizes waste matter; and (4) it reduces storage mass and volume of waste materials. Different levels of micro-organism activity present significant problems in the selection of a waste control system. Author

N70-24962*# Hamilton Standard, Windsor Locks, Conn.
CREW PROVISIONS
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 473-511 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

A freeze-dried diet is the best approach to food and feeding. This basic technique should be supplemented with dried and vacuum-packaged items. Newer techniques such as irradiation and osmotic drying should also be further investigated. Personal hygiene consists of grooming, dental hygiene, selective body cleaning, and whole body cleaning. Grooming equipment includes vacuum devices for collecting nail and hair clippings, an electric hair clipper, and electric razors. Dental hygiene is accomplished with an electric toothbrush, using a liquid dentrifice. Reuseable wipes are provided for selective body cleaning. A head-in shower is selected as the best approach to whole body cleaning primarily on the basis of psychological acceptability and cleaning thoroughness. These advantages compensate for relatively high equivalent weight. Author

N70-24964*# Hamilton Standard, Windsor Locks, Conn.
SELECTED EC/LS SYSTEMS
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 573-688 (See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Based on the results of the AILSS study, total equivalent weight (TEW), although extremely critical during any actual flight hardware design, is not significantly affected by the type of power/heat source. The other primary criteria, crew time and reliability, are also not strongly effected by power/heat source selection at the EC/LS system level. In summary, although the subsystems designs selected for the general system and each of the three specific systems have significantly different weight and power requirements, the basic concepts do not vary greatly. This is because of the AILSS selection criteria emphasis on maintenance and reliability and because of the assignment of similar weight penalties to the power sources. This leads to the selection of baseline concepts which, with minor modifications, are essentially independent of the power supply/heat source. As a result of this study, it is evident that a practical regenerative AILSS, suitable for the support of nine men for a 500-day non-resupply mission, is within the state-of-the-art projected for the 1976 and 1980 period, provided the concepts selected for the AILSS undergo extensive and concentrated development effort starting early 1970. This must be followed by comprehensive manned system testing. Author

N70-24965*# Hamilton Standard, Windsor Locks, Conn.
PACING TECHNOLOGY
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 697-713
(See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

Pacing technology discussed presents a summation of the research and development which is anticipated throughout the study. The primary attention of this section is focused on critical areas of the selected AILSS systems that require concentrated research and development effort. Considered are: (1) oxygen and nitrogen storage materials and fabrication processes; (2) vapor diffusion subsystems for water reclamation; (3) design of bladderless water storage tanks; (4) waste control by vacuum decomposition process; (5) solid electrolyte cell for oxygen generation; (6) carbon dioxide adsorption and removal; (7) food selection and storage; (8) liquid-gas phase separation; (9) pressure sensors and bioluminescent microbiological measurements; and (10) alternate system concepts. Author

N70-24966*# Hamilton Standard, Windsor Locks, Conn.
DILUENT STUDY
In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 715-738
(See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 06K

This study considers the changes in system weight and power that would result if the diluent were changed from nitrogen to either helium or neon, assuming unchanged functional performance. To make the study more useful, this was done for both relative (normalized) power and specific AILSS total equivalent weights. A list of gas mixtures, pressures, and pertinent properties is included. Author

N70-25051# Royal Aircraft Establishment, Farnborough (England).
IMPACT VIBRATIONS IN HUMAN WALKING [UEBER STOSSERSCHUETTERUNGEN BIEM GANG DES MENSCHEN]
R. Gunther Nov. 1969 18 p refs Transl. into ENGLISH from Intern. Z. angew. Physiol. (W. Berlin), no. 25, 1968 p 130-141
(RAE-Lib-Trans-1388) Avail: CFSTI

Impact vibrations in walking and running on surfaces of different consistency (elastic floor, concrete, and lawns) were investigated using accelerometers attached to the head, pelvis and heel. 31 subjects (18 men and 13 women) were used and the accelerations measured ranged from 23-31 g at the heel, 1.1-2.1 g at the pelvis and 0.6-1.1 g at the head. The duration of the vibrations was measured and the velocity of propagation of the impact wave was calculated. The intensity of the impact was attenuated during propagation through the body, the values at the pelvis and the head being 1/17 and 1/27 respectivaly of those measured at the heel. In walking and running, the impact vibrations were the same for men and women when measured at the heel. In men the values obtained at the pelvis and head whilst running were about twice those recorded at the heel. Due to the different damping characteristics the values recorded for women at the pelvis were about 50% greater than those of men and at the head about 20% less. No correlation was found between the impact vibrations and body weight of the subjects. Author

N70-25074# Flying Personnel Research Committee, London (England).
INSPIRATORY AIRFLOW PATTERNS IN SUBJECTS AT REST AND DURING SPEECH WITH AND WITHOUT ADDED EXPIRATORY RESISTANCE
G. R. Sharp and G. A. Patrick Jul. 1969 23 p refs
(FPRC/1289) Avail: CFSTI

Inspiratory flow patterns were analyzed using an analog computer, with subjects at rest and during speech with and without added expiratory resistances. It is shown that speech causes a marked increase in the resting peak inspiratory flow, and in the rate at which the flow changes, as compared with resting values. The imposition of expiratory resistances during speech further modifies the inspiratory flow pattern causing significant increase in the peak flow and rate of change of flow over values obtained with unrestricted speech. Inspiratory flow patterns which include 95 per cent of the observations obtained in this study are given for subjects at rest and during speech with and without imposed expiratory resistances. Since expiratory resistance during speech may occur in flight as a result of mask hose pumping, this condition imposes one of the most severe demands on oxygen equipment. It is noted, however, that the limit values of inspiratory peak flow and rate of change of flow laid down in current specifications for the design of oxygen systems, will meet the additional demands imposed by this condition in the resting subject. Author

N70-25091# Flying Personnel Research Committee, London (England).
FURTHER EVALUATION OF THE IRN HOT ESCAPE SUIT
J. R. Allan and R. W. J. Needham Jul. 1969 15 p refs
(FPRC/MEMO-247) Avail: CFSTI

Further tests of the hot escape suit were undertaken in conditions of 70 C DB/52 C WB, and at rest and stepping routines were devised to simulate the actual escape circumstance. Additional tests were made to assess insulation. It is concluded that the suit will probably give the protection required although realistic testing is not possible. Author

N70-25118# Catholic Univ. of America, Washington, D.C.
A NEW APPROACH TO IMPACT ATTENUATION
Nicholas Perrone (ONR) Feb. 1970 24 p refs
(Grant NSF GK-2802)
(Rept-15) Avail: Issuing Activity

Impact attenuation associated with vehicle related accidents is reviewed. Technical and economical problems that arise in the design of energy absorbing devices are discussed. The main technical problems are very large deformations and rate sensitivity effects. A very brief overview of important recent developments in analyzing for rate sensitivity effects is given. A specific new generic structural element is suggested for impact attenuation: the tube. Preliminary calculations have been performed to determine design curves for steel tubes. Application of this energy absorbing element for various parts of the vehicle are discussed in some detail. A discussion is also contained of the overall problem of crashworthiness; a unit crashworthy element is recommended. Author

N70-25189*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
[COMMUNICATIONS BIOPHYSICS: THE TEMPORAL STRUCTURE OF ELECTROPHYSIOLOGICAL DATA, MARCH 16, 1970] Quarterly Status Report, 1 Dec. 1969 - 28 Feb. 1970
Stephen K. Burns and Roger G. Mark 16 Mar. 1970 13 p refs
(Grant NGL-22-009-304)
(NASA-CR-109407) Avail: CFSTI CSCL 06B

Most effort has been focused on the electrical characterization and display of ectopic heartbeats appearing in the electrocardiogram. The greater part of this effort has been spent in developing data acquisition instruments. The design of the analog input-output interface for our digital data processor has been completed. This interface can accommodate 16 analog input channels, 16 digital inputs, 4 fully buffered analog output channels, and 16 digital outputs. Construction of the analog input-output circuitry has been completed and is operating nicely. We anticipate repackaging it into a companion cabinet to the Tektronix model 601 display oscilloscope. This system will fit into a 10.5-inch rack cabinet and is highly portable. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-23919# Los Alamos Scientific Lab., N. Mex.
COMBUSTION-MANOMETRIC METHOD FOR SIMULTANEOUS DETERMINATION OF CARBON AND HYDROGEN
Carolyn S. MacDougall, Maynard E. Smith, and Glenn R. Waterbury 12 Sep. 1969 7 p refs
(Contract W-7405-eng-36)
(LA-4260) Avail: CFSTI

A combustion-manometric method was used to determine small amounts of carbon and hydrogen in various materials. The sample is burned at 1000 C in a fused-silica furnace containing Alundum chips and cupric oxide to support the sample and ensure complete oxidation. The water formed from the hydrogen in the sample is collected in a trap cooled by an ethanol-dry ice mixture, and then measured monometrically at 100 C. The carbon dioxide produced from the carbon in the sample passes through the first trap, is collected in a second capillary trap cooled by liquid nitrogen, and is measured manometrically at room temperature. Several materials, including tantalum, plutonium, and (uranium, plutonium) dioxide, were analyzed for carbon and hydrogen in this manner. Author (NSA)

N70-24018# California Univ., Berkeley.
A STUDY OF SYNTHETIC REACTIONS OF GASEOUS COMPOUNDS FORMED AT HIGH TEMPERATURES CONTAINING GROUP 3, 4, AND 5 ELEMENTS IN LOW VALENCE STATES. Final Report, 26 May 1966 - 30 Jun. 1969
Peter L. Timms 1969 4 p refs
(Contract DA-31-124-ARO(D)-465)
(AD-698476; AROD-6366.4-C) Avail: CFSTI CSCL 7/2

The report summarizes work concerned with the preparation and study of various high temperature molecular and atomic species of boron, silicon germanium, and phosphorus. It had has three objectives. First, to design apparatus for making high temperature species at low pressures on a preparative scale. Second, to try to make new high temperature species and characterise them. Third, and most important, to use the high temperature species as reagents in synthesis of new types of inorganic or organic compounds. Author (TAB)

N70-24023# Case Western Reserve Univ., Cleveland, Ohio. Electrochemistry Research Lab.
THE ELECTRODE KINETICS OF THE CHROMOUS-CHROMIC COUPLE Technical Report
Sandra S. Donovan and Ernest Yeager 1 Oct. 1969 145 p refs
(Contract N00014-67-C-0389)
(AD-699132; TR-24) Avail: CFSTI CSCL 7/4

The (Cr(H2O)6)(+2)/(Cr(H2O)6)(+3) couple has been studied with cyclic voltammetry on a hanging mercury electrode in acidic perchlorate, chloride-perchlorate, and bromide-perchlorate supporting electrolytes at controlled ionic strength and pH. In addition to the simple hexaaquochromium(II)/(III) couple, the chromium chloride ion and bromide ion couple were studied. Concentrations of the reacting species at the electrode surface were computer calculated from the diffusion coefficients using the experimental current-time data, with no a priori assumptions concerning the dependence of the kinetics on potential double layer corrections were applied. For both of the halogen containing couples, the first order standard rate constants (not considering surface coverage with halogen ions) show a dependence on bulk halogen concentrations. The experimental free energies of activation for the hexaaquochromium(II)/(III) heterogeneous and homogeneous reactions were compared with the values predicted by weak interaction theory. Theory and experiment both show that the free energy of activation for an electrode reaction is about half of that for its homogeneous counterpart when the most probable distance of separation between the reactant and the electrode in the activated state is twice the radius of the reactant. Author (TAB)

N70-24033# Colorado Univ., Boulder.
VAPOR PHASE CALORIMETRY Final Report, 1 Feb. 1965 - 31 Aug. 1969
John R. Lacher and Joseph D. Park Nov. 1969 53 p
(Grants AF AFOSR-810-67; AF AFOSR-810-65)
(AD-699249; AFOSR-70-0036TR) Avail: CFSTI CSCL 7/4

Using a palladium on charcoal catalyst, the hydrogenation reactions of CF3CH2Cl, CF3CHCl2, n-C4H9Cl, and sec-C4H9Cl proceeded quantitatively at 250C and are suitable for calorimetric study. The hydrogenation of CH2 = CHF, CH2 = CF2, CHF = CF2, and CF2 = CF2 proceeded quantitatively at 120C and the heats of reaction were measured at this temperature. The hydrogenation of these fluoro-olefines at 250C produced considerable amounts of HF which, at this temperature, was very corrosive to the tantalum reaction chamber. Author (TAB)

N70-24073# Chicago Univ., Ill. Dept. of Chemistry.
PARAMAGNETIC RESONANCE ABSORPTION
Clyde A. Hutchison, Jr. 4 Dec. 1969 13 p
(Contract AT(11-1)-294)
(COO-294-9) Avail: CFSTI

All the magnetic resonance spectrometers were reconstructed. Very good single crystals of NpF6 in UF6 at a concentration of a few mole percent were prepared. Studies were undertaken of the photoexcited states of Nd(3+), Er(3+), and some other rare earth ions in several different crystals. By means of a bimodal cavity microwave power was pumped into one of the hyperfine lines of the EPR absorption of U(3+)-235 in LaCl3 while observing the EPR absorption of a second hyperfine line. The EPR spectra of photoexcited anthracene was studied. EPR and ENDOR experiments were also carried out on benzene. The ENDOR spectrum of phenanthrene photoexcited molecules was obtained. The intermediate neglect of differential overlap (INDO) calculations were made on diphenylmethylene. Theoretical studies were carried out on proton

hyperfine interactions in triplet state organic molecules at zero magnetic field and at very low magnetic fields. EPR studies are being made on the kinetics of chemical reactions. NSA

N70-24089# Texas Technological Univ., Lubbock. Dept. of Chemistry.
ION RADICALS OF ORGANIC SULFUR, SELENIUM, TELLURIUM AND PHOSPHOROUS COMPOUNDS Final Report, 1 Oct. 1968 -30 Sep. 1969
Henry J. Shine 6 Nov. 1969 17 p refs
(Grant AF-AFOSR-69-1635)
(AD-698790; AFOSR-69-3027TR) Avail: CFSTI CSCL 7/3

The report summarizes work on the chemistry of cation radicals, charge-transfer spectroscopy and anion/radicals of Group IIIA organometallic compounds. In particular it describes (a) the mechanism of reaction of thianthrene cation radical with water and aromatics, (b) charge-transfer spectroscopy in the pyridine-TCNE systems, (c) charge transfer between thianthrene and iodine bromide, (d) the reaction of tri-1-naphthylboron with sodium and sodium amalgam. Author (TAB)

N70-24093# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
GAS CHROMATOGRAPHIC ANALYSIS OF LACQUER SOLVENTS CONTAINING NAPHTHA DILUENT
George G. Esposito Dec. 1969 16 p refs
(AD-699324; CCL-274) Avail: CFSTI CSCL 11/3

Certain solvent types used in surface coatings tend to form free radicals when exposed to solar radiation. Radicals are extremely unstable and are capable of multiple reactions, some of which produce undesirable end products that contribute to air contamination. The object of this investigation was to provide an analytical test procedure which is suitable for the determination of photochemically reactive solvents in the presence of petroleum hydrocarbons. Gas-liquid chromatography was used for the identification and determination of lacquer solvents. The analysis was made possible through the use of a highly selective fractionating column which rejects saturated hydrocarbons, thus allowing the isolation and determination of the principal solvents. Author (TAB)

N70-24119# Naval Research Lab., Washington, D.C.
DESORPTION OF CO2 FROM A THREE-COMPONENT SOLUTION Final Report
S.T. Gadomski and R. R. Miller 8 Dec. 1969 18 p refs
(AD-699151; NRL-6976) Avail: CFSTI CSCL 7/1

New absorbent solutions containing three components have been evaluated for efficiency in decreasing the ambient CO2 level aboard submarines. One of the absorbent systems investigated consisted of a high-boiling organic compound, sulfolane, which has a high physical absorption capacity for CO2, combined with monoethanolamine and water. The other absorbent system has the same components except for the amine, which was 3-aminopropanol. At the same level of saturation of the solutions with CO2, the absorption efficiency of the three-component solutions is about the same as, or slightly inferior to, the corresponding two-component aqueous amines. However, desorption results with the three-component solutions are so much better than for the two-component aqueous amines that the lower CO2 loadings that would be attained in the absorber section of the present CO2 scrubbers should result in significant reduction of the ambient CO2 concentrations in nuclear submarines. Author (TAB)

N70-24122# Michigan Univ., Ann Arbor. Dept. of Chemistry.
LOW TEMPERATURE CHEMICAL THERMODYNAMICS PROJECT Technical Progress Report, Nov. 1968 -Nov. 1969
1 Nov. 1969 49 p refs
(Contract AT(11-1)-1149)
(COO-1149-157; TPR-17) Avail: CFSTI

Several actinide and lanthanide compounds and other materials of nuclear relevance were prepared and various thermodynamic properties have been or are being studied. The enthalpy of combustion and the derived enthalpy of formation for triptycene were determined by rotating oxygen bomb calorimetry and preliminary calculations made for estimation of strain energy. Values were compared with those calculated for bicyclo [2.2.2] octane and bicyclo [2.2.2] octene. Similar studies were carried out on paracyclophane. Investigations on the thermodynamic properties of bicyclic globular molecules were continued. An attempt was made to correlate data on the transition and fusion of globular molecules of bicyclo [2.2.2] heptane, -octane, and -nonane. Heat capacity measurements were conducted on FeMoO4 and FeWO4 from 5 to 350 K. NSA

N70-24123# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
PLUTONIUM ANION EXCHANGE FROM CONCENTRATED SOLUTIONS
Roy E. Jones 31 Oct. 1969 12 p refs
(Contract AT(29-1)-1106)
(RFP-1408) Avail: CFSTI

Plutonium purification by anion exchange from nitrate solutions of high plutonium concentration was investigated using 6-inch-diameter by 30-inch-long ion exchange columns. The process was not recommended to replace plutonium purification by hydrogen peroxide precipitation because of relatively poor americium removal and excessive requirements for equipment. Author (NSA)

N70-24147# Stanford Research Inst., Menlo Park, Calif.
RADIATION-INITIATED EMULSION OXIDATION Final Report, 1 May 1968 -30 Jun. 1969
Dale E. Van Sickle, Jane K. Castleman, Dale G. Hendry, and Constance W. Gould 30 Jun. 1969 34 p refs
(Contract AT(04-3)-115)
(TID-25265) Avail: CFSTI

Investigations were made of emulsion polymerization and oxidation where ionizing radiation was used to initiate the free radicals. The effects of oxygen on the radioinduced emulsion polymerization of styrene were studied. The oxygen strongly inhibited the rate of monomer consumption. For most substrates oxidized in water emulsion, the rate was nearly independent of the emulsifying agent used. NSA

N70-24148# Oregon State Univ., Corvallis.
RADIATION CHEMISTRY, PHOTOCHEMISTRY AND EXCITED STATES OF OXYANIONS AND DNA Comprehensive Report, 1 Jan. 1967 -Oct. 1969
Malcolm Daniels Oct. 1969 19 p refs
(Contract AT(45-1)-2014)
(RLO-2014-9) Avail: CFSTI

Investigations of the radiolysis of concentrated aqueous solutions are reported under the following headings: gamma radiolysis of concentrated aqueous NaNO2 solutions; pulse radiolysis of concentrated nitrate solutions; uv photolysis of nitrate solutions; and gamma radiolysis of UNO3, KNO3, CsNO3, and Cs(NO3)2. Studies on the radiation chemistry and photochemistry of DNA are reported. Flash photolysis of halogen-substituted and methyl-substituted uracils and of thymine is discussed. NSA

N70-24149# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
MODIFIED FORTRAN 4 PROGRAM FOR GAS PHASE RADIOLYSIS DATA REDUCTION
George J. Werkema 24 Oct. 1969 12 p refs
(Contract AT(29-1)-1106)
(RFP-1404) Avail: CFSTI

This program is a modification of one written earlier for a small computer. The availability of a computer having a

medium-to-large memory permits various improvements to be made in operating convenience. The present version, RADF-2, is written in E-level FORTRAN IV for the IBM 360/40G computer. The RADF-2 program converts analytical data obtained at several times during a gas phase radiolysis experiment into the molar and molecular quantities, which may be plotted or further reduced to "G" values. The computed results are output in tabular form for each gas, along with the computed radiation dose, as a function of time. NSA

N70-24150# Auburn Univ., Ala. Dept. of Chemical Engineering.
SYNTHESIS, IDENTIFICATION, AND PURIFICATION OF C6 AND C7 FLUOROCARBONS FROM RADIOLYSIS Annual Progress Report
W. C. Askew, C. H. Ward, J. R. Wright, and G. W. Carey Nov. 1969 20 p refs
(Contract AT(40-1)-3909)
(ORO-3909-1) Avail: CFSTI

Gas chromatographic methods for analyzing perfluoroalkanes were developed. Purification techniques for purifying perfluoroalkane isomers were developed and normal perfluorohexane was purified from a mixture of perfluorohexane isomers. Samples of C2F6, C3F8, and n-C4F10 with and without carbon granules were irradiated by Co-60 gamma rays. Author (NSA)

N70-24151# California Univ., Berkeley. Lawrence Radiation Lab.
PHOTOELECTRON SPECTROSCOPY: A CHEMICAL TOOL FROM NUCLEAR SPECTROSCOPY
Jack M. Hollander Aug. 1969 41 p refs Presented at the Intern. Conf. on Radioact. in Nucl. Spectry., Nashville
(Contract W-7405-eng-48)
(UCRL-18972; CONF-690818-8) Avail: CFSTI

The development of photoelectron spectroscopy and some of its applications are reviewed. Solid or gaseous samples are exposed to a flux of x rays of known energy and the photoelectrons expelled are energy analyzed in the spectrometer. Examples of application of the method are given. NSA

N70-24154# Bureau of Mines, College Park, Md. College Park Metallurgy Research Center.
PROPERTIES OF AN ION EXCHANGE RESIN WITH HIGH SELECTIVITY FOR GOLD
T. E. Green and S. L. Law Mar. 1970 12 p refs
(BM-RI-7358) Avail: Issuing Activity

A commercially available ion exchange resin with high selectivity for gold was investigated as a potential method to collect gold from solution. The resin was found to quantitatively collect gold from acid solutions over a wide range of acid concentrations. Common metals were not collected by the resin nor did they seriously interfere with the collection of gold. X-ray spectrographic and neutron activation methods based on the use of papers containing this resin are proposed. Author

N70-24157# Stanford Research Inst., Menlo Park, Calif.
SENSITIVITY FUNDAMENTALS Semiannual Technical Progress Report, 16 Mar. –15 Sep. 1969
M. E. Hill, R. W. Wolfolk, D. Tegg, R. Shaw, and D. S. Ross 15 Nov. 1969 67 p refs
(Contract Nonr-3760(00))
(AD-698500; SATR-69-2) Avail: CFSTI CSCL 7/4

The effect of confinement on the initiation of low-velocity detonation (LVD) was studied with particular emphasis on the confinement strength and charge length. Using 1,2-bis(difluoramino)-2-methylpropane (IBA) as a model compound, it was found that there was a slight increase in the apparent LVD gap sensitivity when the ratio of charge length L to the charge diameter D was increased threefold. Studies with both IBA and ethyl nitrate indicate that for these compounds the use of a witness plate as an LVD detector causes only a slight increase in the apparent LVD gap sensitivity. Work was also concentrated on refining previous shock temperature calculations on unreacted carbon tetrachloride and nitromethane. In particular, a more satisfactory form of the Hugoniot, was incorporated. The decomposition of vibrationally excited CH3NF2 was studied, and through appropriate RRKM analysis the rate parameters for CH3NF2 yielding 2HF + HCN were determined. Author (TAB)

N70-24184# Naval Scientific and Technical Information Centre, Orpington (England).
THE HANDLING OF AUTOMATIC DATA IN GAS CHROMATOGRAPHY
J. Baudisch Sep. 1969 10 p refs Transl. into ENGLISH from Chromatographia (German), v. 1, 1968 p 443–445
(AD-698660; NSTIC-Trans-2189; NSTIC/24010/69) Avail: CFSTI CSCL 7/4

The increasing demands for accuracy and reliability of analytical data as well as the necessity, brought about by increasing wage costs, of rationalizing laboratory work, led to the idea of using computer-controlled data-handling equipment in gas chromatography. The tasks involved the basic construction and principle of operation, the advantages and disadvantages of data-handling equipment for gas chromatography using a computer as central unit are described. Author (TAB)

N70-24263# California Univ., Santa Barbara. Dept. of Chemistry.
PRESSURE DEPENDENCE OF BENZOPHENONE PHOSPHORESCENCE Technical Report
J. D. Simpson and H. W. Offen 20 Nov. 1969 22 p refs
(Contract N00014-69-A-0200-8002)
(AD-698261; TR-19) Avail: CFSTI CSCL 7/4

The phosphorescence spectrum, intensity and lifetime of benzophenone have been studied at 77K as a function of pressure (0-30 kbar) in EPA, polymethylmethacrylate (PMMA), and polyethylene (PE). At 30 kbar the triplet energy is raised 90/cm in EPA and lowered about 460/cm in PMMA and PE, according to the pressure-induced, reversible shift of the band origin. The triplet lifetime in EPA is reduced from 5.8 to 4.5 msec at 30 kbar pressure. A decrease in phosphorescence intensity suggests that the radiative transition probability diminishes under pressure. The intensity decay becomes strongly nonexponential in polymer matrices under compression. Author (TAB)

N70-24270# Aerojet-General Corp., El Monte, Calif. Space Div.
CARBORANE CHEMISTRY: SYNTHESIS AND POLYMERIZATION Final Report, 1 Mar. 1964 –31 Dec. 1969
Robert E. Williams and Jerome F. Ditter 3 Dec. 1969 33 p refs
(Contract Nonr-4381)
(AD-699146) Avail: CFSTI CSCL 7/3

Discussed are the accomplishments of a five year research program concerning carboranes. A high-yield, continuous flow synthesis of C2B3H5, C2B4H6, and C2B5H7 involving direct reaction between pentaborane-9 and acetylene was discovered, and a pilot plant capable of turning out a pound-per-hour of product was built and operated. C2B5H7 polymers have been synthesized, and, as might have been expected because of the smaller carborane moiety, they are somewhat less crystalline and more elastic than their C2B10H12 counterparts. Also, improvements in elastic properties were achieved by incorporating small percentages of larger molecules, such as vinyl-C2B10H12, in the polymer chains. Also briefly discussed are 18 technical reports which were issued during the research period. Author (TAB)

N70-24357# Signals Research and Development Establishment, Christchurch (England).
QUANTUM COUNTER ACTION IN DIVALENT RARE EARTH SYSTEMS

M. B. Brown, W. A. Shand, and J. M. Williams Jul. 1969 12 p refs
(SRDE-69030) Avail: CFSTI

Quantum counter action has been observed in divalent rare earth doped ions lattices. This report presents the experimental work that has been done on Sm(2+) and Tm(2+) singly doped and Sm(2+): Tm(2+) double doped systems in order to investigate the nature and efficiency of the schemes. The results show that while these systems are more efficient per ion than the trivalent rare earth doped systems the lower concentrations possible bring the overall efficiency back to the same level. Author (ESRO)

N70-24375# Sandia Corp., Albuquerque, N. Mex. Industrial Hygiene Div.
ATOMIC ABSORPTION MICROSAMPLING OF LEAD, CADMIUM, INDIUM, AND THALLIUM IN URINE
Frank Torres Dec. 1969 22 p refs Sponsored by AEC
(SC-RR-69-784) Avail: CFSTI

Urine samples and standard spiked urine samples are made alkaline to a pH of 8. Dithizone in methyl isobutyl ketone (MIBK) is added to the samples and shaken to extract the metals. The MIBK layer is separated from the urine layer, centrifuged, and the emulsion-precipitate is separated from the liquid layers. The precipitate is either brought to a volume of 5 milliliters (ml) with water and mixed well or dissolved in dilute acid. The solution is placed in a sampling boat, where it is dried, and the concentration of the metal is determined by the "sampling boat" technique. The detection limits vary for each metal, but are improved over aspiration methods. Author (NSA)

N70-24385# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID AND CHLORINE DIOXIDE FLAMES
A. R. Hall, G. S. Pearson, T. Combourieu (Orleans Univ.), and R. Moreau (Oreleans Univ.) Feb. 1969 26 p refs
(RPE-TR-69/4) Avail: CFSTI

Premixed flame properties of methane with perchloric acid and chlorine dioxide are compared. Overall activation energies are calculated for several flames with these oxidizers using the van Tiggelen expression. The values so obtained are compared with those for methane-oxygen flames. It is concluded that perchloric acid and chlorine dioxide flames have predominantly the same reaction steps, and a common mechanism is proposed. The mechanism of catalysis of ammonium perchlorate combustion is discussed. Author (ESRO)

N70-24391# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF THE DEGRADATION OF PHENOLIC RESINS [CONTRIBUTION A L'ETUDE DE LA DEGRADATION DES RESINES PHENOLIQUES]
Genevieve Gautherot (Ph.D. Thesis—Paris Univ., 24 Oct. 1968) 1969 61 p refs In FRENCH; ENGLISH summary
(ONERA-P-127) Avail: CFSTI

Thermal degradation of phenolic resins was studied using continuous infrared absorption analysis of the volatile products (CO, CO2, CH4, H2, H2O) obtained. Five samples, three resols and two novolaques were prepared, their reproducibility being assumed by thorough normalization of polycondensation reactions and by reticulation technique in an inert atmosphere. The material was reduced to a thin film. The thermal degradation of these samples was obtained in an inert atmosphere either by programmed heating or at constant temperature. The graphs obtained give total gas quantities varying according to the nature, the chemical composition, and the preparation method of the resins. They make possible the determination of the temperatures at which each gaseous emanation is initiated, reaches its maximum, and becomes evanescent. Spectral analyses of the solid residuum were made at these temperatures, and have shown a correlation between the structural variations of the resins during decomposition and the gaseous emanations. Author (ESRO)

N70-24422 Wisconsin Univ., Madison.
ELECTROGENERATIVE CHEMICAL PROCESSES
Sergei Yurchak (Ph.D. Thesis) 1969 406 p
Avail: Univ. Microfilms: HC $18.45/Microfilm $5.20 Order No. 69-12437

The electrogenerative hydrogenation process is characterized with respect to substrate structure and catalyst. Hydrogen and substrate, physically separated by a perchloric acid electrolyte barrier, were reacted on platinum-, palladium- and ruthenium black cathodes. The substrates were cyclohexene, 1,2-dimethylcyclohexene, benzene, fluorobenzene, hexafluorobenzene and toluene. Products were analyzed by gas chromatography. Kinetic analyses were based on Tafel slopes which were corrected for the effect of mass transfer in the porous electrodes by the simple pore model. The design of a cell for operation with liquid substrates is described. Platinum back was found to be the best simple catalyst for effecting electrogenerative hydrogenation. For cyclohexene, the activity order was: platinum> palladium >> ruthenium; for aromatic compounds, the activity order was: platinum >> palladium approximately ruthenium. Olefins were generally more reactive than aromatics. Dissert. Abstr.

N70-24451 Minnesota Univ., Minneapolis.
THE DYNAMICS OF SPHERICAL, LIQUID-VAPOR PHASE CHANGE IN CONSTANT AND TIME-DEPENDENT PRESSURE FIELDS
Theofanis G. Theofanous (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-20064

A single theory applicable to both vapor bubble growth and collapse in one component systems was formulated and applied successfully to available experimental data. Nonequilibrium phenomena occurring at the vapor-liquid interface, the variation in the density of the vapor, and the variation in the pressure field in the liquid have been included in the theory which encompasses and spans the limits of the inertia and heat transfer controlled regimes. Applications of the theory yielding numerical solutions are illustrated with cryogenic fluids, normal liquids, and liquid metals. At small departures from equilibrium (low superheating or subcooling, or a slow pressure change), the controlling mechanism is seen to be the heat transfer in the liquid (thermal effect). As the departure from equilibrium increases, the finite rate of heat and mass transfer at the interface (non-equilibrium effect) and the momentum of the liquid (inertia effect) become increasingly important, even dominating for an extensive part of the time history. Dissert. Abstr.

N70-24458# California Univ., Berkeley. Lawrence Radiation Lab.
CRYSTALLOGRAPHY AND THERMOCHEMISTRY OF SOME CHLOROCOMPLEX COMPOUNDS OF THE LANTHANIDE AND ACTINIDE ELEMENTS
Lester Robert Morss (Ph.D. Thesis) Aug. 1969 262 p refs
(Contract W-7405-eng-48)
(UCRL-18951) Avail: CFSTI

Several complex compounds containing lanthanide and actinide (III) or (IV) ions in sixfold chloride coordination were prepared in amounts ranging from several grams to one microgram. Preparative techniques for compounds Cs2NaMCl6 (M = trivalent cation) and Cs2MCl6 (M = tetravalent lanthanide or actinide cation) are discussed. Structures of these compounds were studied by the X-ray powder method. All compounds Cs2NaMCl6 that were prepared are face-centered cubic; the lattice parameter of Cs2NaBkCl6 is 10.805(3) A. The synthesis and chemical analysis of a new compound of Bk(IV), Cs2BkCl6, are described; this compound is hexagonal, with a = 7.450(3), c = 12.098(5) A. (Error limits represent 95% confidence.) The principles of design and the

experimental operation of some solution microcalorimeters are described. Heats of solution of standard substances, of lanthanide and actinide metals, and of compounds Cs2NaMCl6, are reported. Author (NSA)

N70-24461 Georgia Inst. of Tech., Atlanta.
THE IMPROVEMENT IN SEPARATION OF CONCENTRIC TUBE THERMAL DIFFUSION COLUMNS
Ho-Ming Yeh (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19649

The convective currents produced by the temperature gradient in a thermal diffusion column have two conflicting effects: the desirable cascading effect which is necessary in securing high separation, and the undesirable remixing effect. It appears, therefore, that proper control of the convective strength might effectively suppress this undesirable remixing effect while still preserving the desirable cascading effect, and thereby lead to improved separation. The improvement in the degree of separation of a concentric tube thermal diffusion column by means of a wire spiral, having a diameter equal to the annular spacing and inserted as a spacer in the annular region, was investigated. It was shown that the undesirable remixing effect could be effectively reduced and controlled by this type of wire and a substantial improvement in separation efficiency attained. Dissert. Abstr.

N70-24465# Harry Diamond Labs., Washington, D.C.
CRYSTAL-FIELD SPLITTING AND GROUND-STATE G VALUES OF A SINGLE D ELECTRON IN CALCIUM TUNGSTATE
Clyde A. Morrison Sep. 1969 27 p refs
(AD-699343; HDL-TM-69-19) Avail: CFSTI CSCL 7/4

The crystal-field splitting of a single d electron in calcium tungstate is given. The g values of the lowest Kramers doublet are calculated and compared with the free ion value. Author (TAB)

N70-24514 Pennsylvania Univ., Philadelphia.
A STEADY-STATE ELECTROCHEMICAL CELL STUDY OF THE RATE OF SOLUTION OF OXYGEN FROM WATER VAPOR INTO LIQUID LEAD
Francis Joseph Harvey, II (Ph.D. Thesis) 1969 204 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-21364

The kinetics of the absorption or solution of gaseous oxygen from water vapor into liquid lead has been investigated from both the diffusion and surface controlled point of view. During the investigation an electrochemical method has been devised which permits the rate of the solution reaction to be measured from the steady-state current. Dissert. Abstr.

N70-24536# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.
INTERACTION OF BORON AND CARBIDE WITH AUSTENITIC CHROME-NICKEL STEEL IN A SODIUM MEDIUM [VZAIMODEISTVIE BORA I KARBIDA S AUSTENITNOI KHROMONIKELEVOI STAL'YU V SREDE NATRIYA]
V. P. Smirnov, A. G. Bespalov, B. N. Zolotukhin, and L. V. Pavlinov 1969 24 p refs In RUSSIAN
(FEI-119) Avail: CFSTI

The interactions of boron carbides with steel were investigated with the following results. Boron carbide does not react with austenitic chrome-nickel steel upon immediate contact and in the presence of an air gap at temperatures to 880 C and time duration to 5000 hr. Given a sodium layer between the boron carbide and steel, a reaction occurs which forms the borides Me2B, (Cr,Ni,Mo)yB3, or (Cr,Ni,Mo)5B, Me4B3 or Me5B4, or MeMo, Cr,Ni,Fe. The formation of borides results in the redistribution of steel components expressed by reduced iron and nickel concentrations and an increase in the chromium concentration at the boundary of the boride phase in the steel. The reactions of pure boron and boron carbides are identical. During boron contact with steel, borides are also formed, and at a rate of increase in the boride phase as expressed by the above equation. The reaction of boron carbide with steel in the presence of a sodium layer can be decreased significantly by using a protective chromium covering on the steel. Author (NSA)

N70-24541# National Inst. for Metallurgy, Johannesburg (South Africa).
RAPID ESTIMATION OF URANIUM IN RAFFINATE SOLUTIONS CONTAINING THORIUM BY THE PYRIDYLAZO-NAPHTHOL METHOD
E. B. T. Cook and T. W. Steele 10 Feb. 1969 4 p refs
(NIM-470) Avail: CFSTI

The uranium is extracted into TBP-chloroform solvent, and a red-colored complex is formed by the addition of 1-(2-pyridylazo)-2-naphthol to the solvent. The color is then compared with a set of standards that were treated in a similar manner. The method is applicable to solutions of as low a concentration of uranium as 0.05 g/l, and of as high a concentration of thorium and nitric acid as 60 g/l and 160 g/l, respectively. NSA

N70-24551# Advisory Group for Aerospace Research and Development, Paris (France).
REACTIONS BETWEEN GASES AND SOLIDS Conference Proceedings
Feb. 1970 480 p refs Mostly in ENGLISH; partly in FRENCH
Presented at Propulsion and Energetics Panel 34th Meeting 8th Colloq., Wright-Patterson AFB, Ohio, 13-17 Oct. 1969
(AGARD-CP-52) Avail: CFSTI

Chemical reaction kinetics of gas-solid interactions are studied. Considered are the mechanisms of combustion, ablation, erosion, corrosion, and catalysis in connection with aerospace research. For individual titles see N70-24552 through N70-24580.

N70-24552# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
THE REACTION OF METALS AND ALLOYS WITH GASES AT ELEVATED TEMPERATURES
Robert A. Rapp *In* AGARD Reactions Between Gases and Solids Feb. 1970 12 p refs (See N70-24551 11-06)
Avail: CFSTI

The recent literature has been surveyed for theoretical and experimental contributions to the understanding of scale formation in the high-temperature reaction of metals and alloys with gases. The graphical representation of thermodynamic data is used to identify possible reactions between metals and alloys and gas mixtures. Recent theoretical contributions in alloy oxidation are discussed. The role of grain boundaries of the scale in the dissociative mechanism for protective scale growth has been clarified. An alternating diffusional growth and scale fracture mechanism seems to account for the linear kinetics of scale formation in niobium oxidation. Impurities in the oxide scales of refractory metals probably account for the irrational dependences of these oxidation reactions on oxygen pressure. The design of oxidation-resistant refractory metal alloys is discussed. Minor additions of rare earth and alkaline earth metals to oxidation-resistant alloys continue to be used to effect reduced scaling kinetics and improved scale adherence; the rationalization of this behavior is yet incomplete. Author

N70-24554# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
CHEMISORPTION ON REFRACTORY METALS

T. W. Haas *In* AGARD Reactions Between Gases and Solids Feb. 1970 8 p refs (See N70-24551 11-06)
Avail: CFSTI

The chemisorption of reactive gases (H2, N2, CO and O2) onto the low index planes of the refractory metals Cr, Mo, W, V, Nb, Ta and Re has been studied, using low energy electron diffraction. Trends observed are discussed and contrasted. It is suggested that strong covalent, directional bonds are responsible in many cases for the structures observed, rather than adsorbate-adsorbate lateral interactions. Author

N70-24556# Naples Univ. (Italy).
A MODEL FOR THE INDEPENDENT REVERSIBLE POISONING OF POROUS CATALYSTS BY FEED STREAM IMPURITIES
F. Gioia, L. G. Gibilaro, and G. Greco, Jr. *In* AGARD Reactions Between Gases and Solids Feb. 1970 12 p refs (See N70-24551 11-06)
Avail: CFSTI

A mathematical model is developed for the penetration of a reversible poison that is adsorbed on the catalyst surface; its application to isothermal reaction systems is discussed. The model predictions are found to be in reasonable agreement with experimental results obtained for the hydrogenation of ethylene on a copper-magnesia catalyst in the presence of water vapor which acts as a reversible poison. Author

N70-24557# Aston Univ., Birmingham (England).
THERMIONIC EMISSION OF ELECTRONS IN THE PRESENCE OF ADSORBED GASES
F. M. Page and J. I. Wright *In* AGARD Reactions Between Gases and Solids Feb. 1970 9 p refs (See N70-24551 11-06)
Avail: CFSTI

Many of the gaseous products of combustion are adsorbed on surfaces, even at temperatures above 1500 K and these adsorbed layers strongly affect thermionic emission of electrons. The ionisation of solid particles in flames is therefore not to be compared directly with ionization in vacuum. Experimental work on the systems CO/W, O2 Pt and So2/Pt is presented and analyzed in terms of the heat of adsorption of the gas; and of the kinetics of adsorption. In all these systems there is a large rise in the thermionic work function. Certain systems particularly those involving highly unsaturated organic materials, analogous to soot, have the opposite effect and lower the work function with a consequent large increase in the emission of electrons. Some observations on these systems are discussed and their consequences at low temperatures considered. Author

N70-24558# Max-Planck-Institut fur Metallforschung, Stuttgart (West Germany). Inst. fuer Metallkunde.
KINETICS OF PHASE BOUNDARY REACTIONS BETWEEN GASES AND METALS
H. J. Grabke *In* AGARD Reactions Between Gases and Solids Feb. 1970 14 p refs (See N70-24551 11-06)
Avail: CFSTI

Phase boundary reactions often determine the rate of interactions of metals with gases. Adsorption and stepwise dissociation of the gas molecules must occur before the nonmetal atoms from the gas phase can be dissolved in the metal or can react with the metal. The kinetics of the surface reactions of iron and other metals with NH3-H2, CH4-H2, H2S-H2, H2O-H2, CO2-CO and N2-H2 mixtures have been studied at high temperatures. From the experimentally determined kinetics, the dependence of the forward and backward reaction rate on the partial pressures or activities of the reactants and reaction products, the rate determining step of the investigated reactions could be detected. The rate determining step can also be found out by the comparison of the overall reaction rate with the rate of an appropriate isotope exchange reaction. Depending on the temperature or other reaction conditions different reaction steps can act as the rate determining step of a reaction. Author

N70-24559# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
OXIDATION STUDY OF ZIRCONIUM DIBORIDE WITH VARIOUS ADDITIVES
H. C. Graham and W. C. Tripp (Systems Res. Labs., Inc., Dayton, Ohio). *In* AGARD Reactions Between Gases and Solids Feb. 1970 11 p refs (See N70-24551 11-06)
Avail: CFSTI

The relative oxidation resistances of (1) ZrB2; (2) ZrB2 + 20 v/o SiC; and (3) ZrB2 + 14 v/o SiC + 30 v/o C were studied thermogravimetrically over the range 800 to 1600 C and over a range of three orders of magnitude in oxygen partial pressure. In undoped ZrB2 the relative amounts of B2O3 and ZrO2 formed could be determined by measuring total oxygen consumption and the amount of B2O3 formed. Below 1100 C very little of the B2O3 formed evaporated at the total pressure used (250 mm). The kinetics of the oxidation process were difficult to define and appear to depend on sample composition, temperature, and oxygen partial pressure. Logarithmic and cubic as well as parabolic dependencies were observed in some cases. In those cases where the process was consistent over a wide enough range of conditions, values for the rate constants and activation energies are calculated and compared with values found by other investigators. Author

N70-24560# United Kingdom Atomic Energy Authority, Harwell (England). Atomic Energy Research Establishment.
OXIDATION OF SILICON AND SILICON CARBIDE IN GASEOUS ATMOSPHERE AT 1000 – 1300 C
J. E. Antill and J. B. Warburton *In* AGARD Reactions Between Gases and Solids Feb. 1970 14 p refs (See N70-24551 11-06)
Avail: CFSTI

The behavior of silicon, a self bonded silicon carbide containing silicon and pure silicon carbide has been assessed in carbon dioxide, water vapor, oxygen, carbon monoxide, vacuum and helium at 1000 – 1300 C. Particular attention has been paid to the conditions governing the formation of protective silica films and to the passage of material into the gas phase as SiO and silicon vapor. When silica films are formed a parabolic rate law is in general obeyed and there are no marked differences in behavior of the three materials, with the excpetion that silicon is oxidised more readily than silicon carbide in water vapor at 1000 C. The reactivities of the oxidants decrease in the order water vapor, oxygen and carbon dioxide with carbon monoxide being completely inert. The data have been interpreted on the basis that the silica films grow by the diffusion of hydroxyl ions in water vapor. The formation of SiO with silicon carbide in low partial pressures of oxidant leads to high corrosion rates. It has been deduced that under these conditions silica is an intermediary and the rate determining step is the desorption of the gaseous products. Silicon carbide is not dissociated into silicon vapor and carbon at temperatures < or = to 1200 C although decomposition may be significant at 1300 C. Author

N70-24561# Western Ontario Univ., London. Faculty of Engineering Science.
THE OXIDATION OF NIOBIUM IN THE TEMPERATURE RANGE 350 – 600 C
J. S. Sheasby *In* AGARD Reactions Between Gases and Solids Feb. 1970 16 p refs (See N70-24551 11-06)
Avail: CFSTI

The oxidation properties of niobium were studied in the temperature range 350 deg – 600 C at an oxygen pressure of 380 Torr. Particular emphasis was placed on correlating the reaction products with the oxidation kinetics. The oxidation rate in this

temperature range is predominantly time independent, and a sharp change in the temperature dependence of this linear rate has been detected at 440 C. On the basis of kinetic and metallographic evidence it is considered that above this temperature the linear rate is of the type known as "paralinear" in which the reaction rate is controlled by the diffusional properties of the oxide layer in contact with the metal phase. Below 440 C the morpholcgy of the reaction products is quite different and it appears that the reaction rate is controlled by a surface reaction at an oxide-gas interface. After long periods of oxidation at temperatures above 440 C a localized breakaway reaction occurs. This breakaway reaction is an extreme form of grain boundary attack and causes severe specimen self-heating. However, no evidence was found of a fundamental change in the rate controlling mechanism throughout this transition.
Author

N70-24562# General Electric Co., Evandale, Ohio. Materials and Processes Technology Lab.
THE OXIDATION OF NI-BASE SUPERALLOYS UNDER AIRCRAFT ENGINE CONDITIONS
C. S. Wukusick *In* AGARD Reactions Between Gases and Solids Feb. 1970 12 p refs (See N70-24551 11-06)
Avail: CFSTI

Nickel-base superalloys, utilized extensively in the hot components of jet engines, are subjected to environmental conditions which vary widely dependent on a number of factors. Principal among the critical variables are temperature, pressure, gas velocity, and gas contamination due to ingestion of gaseous, liquid and solid compounds. The basic oxidation behavior of Ni-base superalloys is briefly reviewed. Typical alloys are evaluated as to type of oxides (both surface and subsurface) formed, matrix chemistry changes during oxidation, effects of surface preparation and gas velocity. The phenomenon of accelerated oxidation (hot corrosion) is reviewed. The effects of NaCl in the atmosphere and sulfur in the fuel on the surface stability of typical alloys are examined. Examples of accelerated oxidation encountered in service are presented. The various theories which have been developed to expalin the "hot corrosion" reactions are examined and correlations with experimental observation are attempted.
Author

N70-24563# Vacuumschmelze GmbH, Hanau (West Germany).
REACTIONS BETWEEN HIGH-TEMPERATURE-RESISTANT ALLOYS AND GASES
H. Pfeiffer *In* AGARD Reactions Between Gases and Solids Feb. 1970 14 p refs (See N70-24551 11-06)
Avail: CFSTI

Normally the Gibbs-potential of the reaction between metals and oxygen is much higher than that of any other reactions between solids and gases and, therefore, this process takes place in gases with oxygen of 20% or less, especially in air. The phenomenon of selective or preferential oxidation of the one or the other alloying element is one of the most interesting facts regarding the ate of oxidation processes. It has been discussed in detail on the system of iron-chromium alloys which may be thought to be a model of temperature-resistant alloys. Another important influence has to be attributed to the adhesion between the metallic surface and the oxide scale. It proved to be true for all heat-resistant alloys that diffusion processes are determining the rate of oxidation. Consequently, the growing scale acts as a protective layer, the efficiency depending on the concentration of lattice defects in the oxide scale. But the protective effect will be small unless the demand for a sufficient adhesion is satisfied. A third point of view is the plastic flow of oxide layers which influences the kinetics of oxidation reactions. It reduces the cooling stresses and may cause the oxide scale to remain in tight contact with the metal in spite of the formation of holes due to the preferred migration of metal ions to the otuer surface.
Author

N70-24564# Glasgow Univ. (Scotland).
MECHANICAL PROPERTIES OF SURFACE OXIDE FILMS AND THEIR EFFECT ON THE KINETICS OF OXIDE GROWTH
P. Hancock *In* AGARD Reactions Between Gases and Solids Feb. 1970 12 p refs (See N70-24551 11-06)
Avail: CFSTI

A new technique for measuring the mechanical properties of growing oxide films, by observing the natural frequency of a freely suspended metal specimen, is described. Values are given of the Young's modulus, adhesion and plasticity of oxides on Armco iron and 0.2% carbon steel, at temperatures from 570 to 800 C and on pure nickel, at temperatures from 800 to 1000 C. Young's modulus values on iron decrease with increasing temperature from 27 x 1 million lb in.(-2) at 570 C to 22 x 1 million lb in. (-2) at 800 C. Adhesion values increase with increasing temperature and the value of plastic strain before failure increases from 2 x 0.0001 at 500 C to 10 x 0.0001 at 800 C. The Young's modulus of growing nickel oxide scales varies from 46 - 60 x 1 million to 30 x 1 million lb in.(-2) over the temprature range 800 - 1000 C and its excellent adhesion is explained in terms of the mechanical properties. The influence of mechanical properties on oxidation behavior is demonstrated and the effects of specimen geometry and thermal shock on oxidation behavior are discussed.
Author

N70-24565# United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Materials Lab.
REACTION BETWEEN SOLIDS AND GASES IN RADIATION FIELDS
J. M. Hutcheon *In* AGARD Reactions Between Gases and Solids Feb. 1970 19 p refs (See N70-24551 11-06)
Avail: CFSTI

The paper reviews the effects of reactor radiation on corrosion. In particular it discusses in some detail the reaction between CO2 and graphite under irradiation where the main effects arise from gamma irradiation of the gas. The effects on corrosion rate of dose rate, pressure, temperature, gaseous additives and modifications to the graphite pore structure are described and contrasted, where relevant, with the corresponding effects in the absence of irradiation. Differences are also noted between the thermal and radiolytic processes in regard to the changes in pore structure and mechanical properties derived from corrosion to the same weight loss. A short section is devoted to the changes in the (out-of-pile) reactivity of graphite towards air resulting from pre-irradiation of the graphite by fast neutrons and the effects are compared with other effects of fast neutron damage to graphite. Finally, the paper examines briefly the current state of knowledge concerning the effects of irradiation in the corrosion rate of zirconium alloys in steam or water and related phenomena. It concludes that the effects arise from the production of interstitial oxygen atoms in the zirconium oxide scale but that the explanation of their enhanced mobility is not yet available.
Author

N70-24566# Gottingen Univ. (West Germany). Inst. fuer Physikalische Chemie.
LOW-TEMPERATURE REACTIONS BETWEEN SOLIDS AND GASES
Karl Hauffe *In* AGARD Reactions Between Gases and Solids Feb. 1970 18 p refs (See N70-24551 11-06)
Avail: CFSTI

Because of the fact that all reactions between a solid and a gas are initiated by a chemisorption, in the first chapter of this paper the mechanism of the chemisorption is contributed under the viewpoint of the first step of metal oxidation and the ore reduction. The chemisorption, however, is mainly influenced by the presence of lattice defects and traps in and near the surface. Since often the mass transport through the solid due to a diffusion gradient and/or an electric field is the rate-determining step, the various transport phenomena are discussed. The utility of the understanding of these theoretical relations is demonstrated, especially, by means of the oxidation of nickel and of desorption and evaporation processes in the dark and under illumination. As examples zinc oxide and cadmium sulfide have been chosen.
Author

N70-24573# Saskatchewan Univ., Saskatoon. Dept. of Mechanical Engineering.

DIFFUSION FLAMES OF MAGNESIUM VAPOUR AND OXYGEN AT LOW PRESSURES

B. E. L. Deckker and B. K. G. Rao *In* AGARD Reactions Between Gases and Solids Feb. 1970 14 p refs (See N70-24551 11-06)

(Grant NRC A-1618)

Avail: CFSTI

The combustion of magnesium vapour in a quiescent atmosphere of oxygen and argon has been studied at low pressures (0.5 to 0.9 torr) The gross structure of these flames has been found to depend on the composition of the environment, the pressure in the combustion chamber, and on the temperature of vaporization. Steady flame conditions are difficult to maintain because of the composition of oxide in the nozzle passage, but by the proper selection of the experimental varieties reasonably steady conditions can be achieved for 2 to 4 minutes. The temperature distribution in the flame has been determined using sub-miniature sheathed, and grounded junction, thermocouples. Higher temperatures and lower intensities of emitted radiations have been recorded with decreasing oxygen concentrations. A critical value of oxygen concentration exists below which total combustion of the vapor does not occur. The applicability of Polanyi's dilute diffusion flame method to these flames has been discussed. Reaction rate parameters have been obtained from the temperature pattern method and from the method of photographic photometry. These methods are based on the dilute diffusion flame model, and the results favor the predominance of homogeneous rather than heterogeneous reaction, as has been suggested in the literature. Author

N70-24575# Rocket Propulsion Establishment, Westcott (England).

THE ROLE OF CARBON-GAS REACTIONS IN THE EROSION OF ROCKET NOZZLES

G. A. Heath and R. W. Thackray *In* AGARD Reactions Between Gases and Solids Feb. 1970 15 p refs (See N70-24551 11-06)

Avail: CFSTI

Graphites have excellent physical and mechanical properties for use at high temperatures in uncooled rocket nozzles but undergo erosion, apparently arising from chemical reactions with gaseous combustion products. Recent chemical kinetic data on carbon-gas reactions relevant to rocket conditions have enabled chemical rate controlled erosion to be calculated and compared with experimental observations on specific graphite nozzles. The reactivity of the nozzle surface depends on its temperature which rises progressively during the rocket operation. Preliminary work has shown that at surface temperature up to about 1600 K the erosion agrees with that predicted by a chemical rate control mechanism whereas at higher temperatures the predicted values are too high, probably because of boundary layer effects which hinder transfer of reactants from the free stream to the surface. Among graphites currently available pyrolytic graphite has the lowest reactivity to oxidising gases and the highest resistance to erosion in nozzles. This highly anisotropic material may be used with advantage in practical designs. Author

N70-24576# Plessy Co., Ltd., Towcester (England). Allen Clark Research Centre.

A LABORATORY INVESTIGATION OF CARBON-GAS REACTIONS OF RELEVANCE TO ROCKET NOZZLE EROSION

J. C. Lewis, I. J. Floyd, and F. C. Cowlard *In* AGARD Reactions Between Gases and Solids Feb. 1970 30 p refs (See N70-24551 11-06)

Avail: CFSTI

The interaction of various carbons with oxidising gases present in solid-propellant exhausts (CO_2, H_2O and O_2) was investigated at pressures of 1–3 atmospheres and surface temperatures of 1500–3000 K. The use of high gas flow velocities ensured freedom from boundary layer diffusion control in all but the most reactive conditions studied. Graphs of weight loss rate versus temperature exhibited a maximum and a minimum for reactions in CO_2 and O_2, but not in H_2O. Significant departures from first order behavior were observed in some cases. Variations of the reaction rate with the type of carbon and the reactant gas were in general less pronounced than at lower temperatures. However, the synthetic graphite was still found to be markedly more reactive to CO_2 than pyrolytic graphite or vitreous carbon, the best pyrolytic graphite shells reacting at only 3–4% of the rate of the synthetic graphite. Molecular oxygen was an order of magnitude more reactive than CO_2 or steam, but if due allowance is made for the concentrations of these gases in the exhaust their contributions to the overall erosion rate are $H_2O >> CO_2 >> O_2$ for high temperature propellants, with CO_2 assuming greater importance at lower temperatures. Author

N70-24577# Technische Hochschule Darmstadt (West Germany)

EXPLOSION ELECTRODE EROSION IN NANOSECOND HIGH DENSITY SPARKS

H. Fischer and K. Schoenbach *In* AGARD Reactions Between Gases and Solids Feb. 1970 8 p refs (See N70-24551 11-06)

Avail: CFSTI

Tree shape optical phenomena erupting from the anode of high density nanosecond spark discharges were studied by means of time resolved photography and identified by spectroscopy as explosive erosion jets of electrode material. Observations with different electrode materials and alterations of current density and duration of current flow established conditions for the existence of the jets. The mechanism explaining this explosive anode erosion is derived from comparison of the different electrode materials. It is understood that the effect is produced by a thin-layer melting and evaporation of the spot area of the anode. Thus materials with a low melting point and low heat and electric conductivity favor the existence of directed erosion jets. Author

N70-24578# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

A SCHEMATIC REPRESENTATION OF ABLATION PROCESSES [REPRESENTATION SCHEMATIQUE DES PROCESSUS D'ABLATION]

Jacques Jules Nicolas, Samuel Kohn, and Georges Taguet *In* AGARD Reactions Between Gases and Solids Feb. 1970 12 p refs In FRENCH; ENGLISH summary (See N70-24551 11-06)

Avail: CFSTI

With the introduction of simple chemical mechanisms it is possible to explain some characteristic examples of practical interest of partial ablation. In the absence of mechanical erosion we can apply under a simplified form the laws of chemical kinetics and the laws of transfer through the boundary-layer. The experimental results obtained in well specified conditions are in good agreement with those given by the proposed methods in the case of the following materials: pure phenolic resin, phenolic resin reinforced with graphite fibers, phenolic resin reinforced with silica fibers. Author

N70-24579# Rome Univ. (Italy). Inst. di Chimica Fisica ed Elettrochimica.

THERMODYNAMICS OF VAPORIZATION PROCESSES OF SOLIDS AT HIGH TEMPERATURES

G. De Maria *In* AGARD Reactions Between Gases and Solids Feb. 1970 10 p refs (See N70-24551 11-06)

Avail: CFSTI

The mass spectrometric method has proved to be a powerful

tool for identifying new high temperature species. The principle of the method is discussed together with the thermodynamic procedures employed in the treatment of the data. In particular the thermodynamic behavior of the evaporation process of metal-carbon systems at high temperatures is discussed, in the light of recent mass spectrometric results. A comparison with the thermodynamic properties of gaseous metal-oxide species is presented. A correlation between isosteric and isoelectronic molecules composed of 4-4, 3-5 and 2-6 group elements is reported. Author

N70-24599# Wisconsin Univ., Madison.
WAVELENGTH DEPENDENCE OF PHOTOSTIMULATED TL IN LiF
D. Pearson and J. R. Cameron 15 Jul. 1969 7 p refs
(Contract AT(11-1)-1105)
(COO-1105-149) Avail: CFSTI

Averaged peak heights of the photostimulated thermoluminescent glow curves for lithium fluoride phosphors, corrected for the variation in output of the light source as a function of wavelength, are presented. The photostimulation process includes gamma predose, first heating, uv exposure, and then thermoluminescent measurement. NSA

N70-24650*# Rensselaer Polytechnic Inst., Troy, N.Y.
STRUCTURAL CHARACTERIZATION
In its Mater. Res. Mar. 1970 p 3–27 refs (See N70-24649 11-34)
Avail: CFSTI CSCL 07D

Research on the synthesis and structural characterization of a wide variety of materials are reported. Some highlights of this period follow: (1) An exact description has been formulated for the stress field, deformation field, and swelling distribution around an idealized filler particle in an elastomer. (2) A new organic compound, 1,3-butanediol-3-acetate, has been prepared for the first time as part of the preparation of low-molecular-weight analogs of poly(vinyl acetate/vinyl alcohol) copolymers. (3) By measurements of diffusion coefficients, it is estimated that the effective valence of aluminum dissolved in zinc single crystals is closer to +2 than the expected +3. (4) Several sets of energetic calculations are in agreement with the proposal that the stable interstitial complex formed when a chlorine molecule is introduced in NaCl or KCl consists of the neutral Cl sub 2 molecule occupying adjacent structural voids along a [100] direction. Author

N70-24651*# Rensselaer Polytechnic Inst., Troy, N.Y.
SOLID STATE REACTIONS AND PHASE TRANSFORMATIONS
In its Mater. Res. Mar. 1970 p 28–38 (See N70-24649 11-34)
Avail: CFSTI CSCL 07D

The research is directed towards the achievement of basic transformations for a broad grouping of solid materials, with specific interrelationships to the overall view of materials research. The highlights of the research results during the past program period are as follows: Several studies have been directed towards achieving an understanding of the factors controlling the kinetics of solid state phase transformations. One which may have a significant practical application is the martensite transformation in steels. In studies of the temperature of dependence of the spontaneous polarization in Rochelle salt, it was found that the nuclear magnetic resonance method failed in the higher temperature range where deviations from the molecular field theory are expected. This technique is being applied to the lower temperature ferroelectric to anti-ferroelectric transition in order to determine the details of this transition. Author

N70-24687*# National Aeronautics and Space Administration, Washington, D.C.
MAGNESIUM REDUCTION OF TITANIUM FROM TETRACHLORIDE
N. P. Sazhin et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 250–263 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

As a result of laboratory and industrial studies carried out over a broad range of temperatures and pressures, with simultaneous admission of reagents, on employing new specially developed test methods, the theories of the mechanism of the magnesium reduction of titanium from TiCl4 are confirmed and markedly complemented. It is shown that this process is of an autocatalytic nature and may occur in the kinetic and diffusion regions of heterogeneous catalysis. Under industrial conditions the relationship between the physical characteristics of titanium sponge and the principal technological parameters of the reduction process was determined, as were the apparent activation energy and the temperature of reaction surface; the mechanism of the process of reduction in industrial apparatus was more precisely determined. The results of this investigation confirmed the validity and applicability of the working hypotheses based on autocatalytic nature of the process which makes it possible to improve the apparatus and technological regime of the magnesium reduction process. Author

N70-24688*# National Aeronautics and Space Administration, Washington, D.C.
SODIUM REDUCTION OF TITANIUM FROM TETRACHLORIDE
S. V. Ogurtsov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 264–273 refs (See N70-14659 11-17)
Avail: CFSTI CSCL 11F

The results of an investigation of the sodium reduction of titanium tetrachloride by the two stage method are investigated; during the first stage a molten pool of "black salt," a complex compound of the lower chlorides of titanium, is obtained, and during the second stage this compound is subjected to final reduction to metal in the form of large crystals. The technological parameters for conducting the stage of the process without developing pressure in the reaction vessel are determined. During the second stage conditions for obtaining in the laboratory a high and stable yield of macrocrystalline titanium within the limits of 55–60% were determined for the first time. The possibility of applying the technological regimes on an experimental-industrial scale with satisfactory results is demonstrated. Author

N70-24694# Eidgenossische Technische Hochschule, Zurich (Switzerland).
ON FUSION ELECTROLYSIS OF NIOBIUM [ZUR SCHMELZFLUSSELEKTROLYSE VON NIOB]
Ganda Schenk (Ph.D. Thesis) 1968 144 p refs In GERMAN
(Diss-4235) Avail: CFSTI

Niobium was obtained electrochemically from niobium pentachloride melts at current densities of 0.3 to 3 A/sq cm and at temperature ratios of 650 to 880 degrees. Optimal conditions were: a ratio of 2 to 2.5 percent niobium, 8 percent fluorine, current density of 1 A/sq cm, and temperature of 760 degrees. These conditions resulted in a current yield of 77 percent with the following purities: 410 ppm H, 370 ppm O, 96 ppm N, 493 ppm C, with the sum of metallic impurities below 220 ppm. From niobium pentafluoride containing melts niobium was separated at fluorine content between 5.9 and 18.7 percent and niobium content between 2 and 5 percent at current densities of 1 A/sq cm and at temperatures between 650 and 760 degrees. Optimal conditions for this process were: 2.8 percent niobium, 9.4 percent fluorine, current density 1 A/sq cm, and temperature of 760 degrees. Current yield for these conditions was about 87 percent and the

purities were: 195 ppm Cl, with the sum of metallic impurities smaller than 1544 ppm. The same melts were used to refine niobium with good results. Transl. by G.G.

N70-24696# Eidgenossische Technische Hochschule, Zurich (Switzerland).
LIQUID ALUMINUM BROMIDE AS SOLVENT [FLUESSIGES ALUMINIUMBROMID ALS LOESUNGSMITTEL]
Urs Adrian Ruf (Ph.D. Thesis) 1968 82 p refs In GERMAN
(Diss-4244) Avail: CFSTI

Aqua in liquid aluminum bromide reacts by forming: (1) Br3AlOH2(solvent) yields Br2A1OH(solvent) plus HBr; and (2) Br2AlOH(solvent) yields 0.5(BrA1O)2(solvent) plus HBr. The liquid phase remains homogeneous and contains hydroxyl aluminum bromide and oxoaluminum bromide in liquid phases. Equivalent amounts of AlBr3 and water yield a homogeneous melt that remains highly viscous after cooling; formed are polynuclei of the formula; Br3Al-(OH-AlBr2)n-OH2. Stoichiometric quantities of AlBr3, KBr, and water form crystalline salts with polynuclear anions. Single crystals grown from the salt KAlBr4 possess a monocline structure with the space group P2 sub c or P sub c. Reaction with H2S yields only a loose association with AlBr3 with high temperature dissociation into sulfide and water. It is concluded that AlBr3 is an excellent solvent for alkali halides. Its application for extraction of attached KCl and LiCl can be used to isolate the water soluble intermetallic compound Li2Pt from K2PtCl. Debye values of Li2Pt give a lattice constant of 7.607 A with seven formula units per element cell. Transl. by G.G.

N70-24700# Atomic Energy of Canada, Ltd., Chalk River (Ontario). General Chemistry Branch.
THE DETERMINATION OF COBALT BY CONTROLLED-POTENTIAL COULOMETRY
R. W. Durham and V. Corriveau Nov. 1969 15 p refs
(AECL-3554) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $0.50

An analytical technique for determining cobalt by controlled-potential coulometric titration is described. A stationary gold electrode is used for oxidation and reduction in a supporting electrolyte containing 0.5% EDTA and 1.0% calcium acetate. Oxidation to Co(III) is carried out at + 1.44 volts versus the saturated calomel electrode. This is followed by a pre-reduction at + 0.34 volts and then the cobalt is determined by reducing from Co(III) to Co(II) at − 0.38 volts. In the range from 1 to 2 mg of cobalt the standard deviation of a single result is + or − 0.2%. The method has been used to analyze 1% Co/Al neutron flux monitor wire and the results are compared with those obtained by other methods of analysis. Author

N70-24846# Georgia Univ., Athens.
MECHANISM OF THE FORMATE HYDROGENLYASE REACTION Final Progress Report, 1 Mar. 1967 – 28 Feb. 1969
Harry D. Peck, Jr. 28 Feb. 1969 21 p refs
(Contract AT(40-1)-3626)
(ORO-3626-2) Avail: CFSTI

The current status of formate hydrogenlyase is considered. The formate system was found in both coli-aerogenes group and in the sulfate reducing group, but its exact physiological function remains obscure. It is repressed by oxygen, induced anaerobically in the presence of formate, and heme. It is also shown that a number of metals are required for its formation. J.M.C.

N70-24847# Princeton Univ., N.J. Dept. of Chemistry.
[CATALYTIC STUDIES USING MOLECULAR SIEVES AND MAGNETIC RESONANCE] Annual Progress Report, 1 Jun. 1968 – 31 May 1969
31 May 1969 7 p refs
(Contract AT(30-1)-1158)
(NYO-1158-32) Avail: CFSTI

Catalytic studies using molecular sieves and magnetic resonance/work on these sieves are discussed. The problem of synthesizing gold and palladium particles of uniform size and alumina in the form of ultramecroscopic rods is being studied. The properties of methyl radicals trapped in 40 A pores of Vycor silica are being investigated. Studies are being made of copper in Tutton salts, K2Zn(SO4)2 · 2H2O, and oxygen confined in pores of vycor glass. Iron ferrocene was prepared, supported on Vycor glass, and did not adsorb nitrogen. Wilkinson's triphenylphosphine rodium complex was prepared and its activity characterized. NSA

N70-24851# Eidgenossische Technische Hochschule, Zurich (Switzerland).
POLARIZATION SPECTRA OF SOME NON-BENZOID AROMATIC COMPOUNDS
Robert Jankow (Ph.D. Thesis) 1969 91 p refs *Its* Dissertation No. 4265
Avail: CFSTI

The fluorescence polarization spectra of several non-benzoid aromatic compounds are given. Quinacridone and isoquinacridone were measured in neutral and acid media. These spectra were interpreted on the basis of a simple Hueckel molecular orbital model. Spectrum of 1,2-benzazulene was investigated and interpreted with the aid of configuration interaction calculations of the Parisen – Parr – Pople type. Platt labels for the electronic bands were applied to 1,2-benzazulene on the basis of a partial overlap procedure. Three acetyl-(14)-annulenes electronic spectra were interpreted on the basis of the polarization spectra and a Pariser – Parr – Pople type treatment. Author

N70-24853*# Louisiana State Univ., Baton Rouge. Reacting Fluids Lab.
COMPUTATION OF THE EQUILIBRIUM COMPOSITION OF REACTING GAS-SOLID MIXTURES WITH MATERIAL AND ENERGY BALANCE CONSTRAINTS Status Report
Eduardo G. del Valle and Ralph W. Pike 1 Mar. 1970 25 p refs
(Grants NGR-19-001-016; NGL-19-001-058)
(NASA-CR-66928; RFL-10) Avail: CFSTI CSCL 07D

The computation of chemical equilibrium composition for a multicomponent, polyphase system requires the minimization of the equation which expresses the free energy of the system subject to mass balance constraints. At low temperatures the equilibrium composition of the degradation products of nylon-phenolic resin ablative composites are not in agreement with experimentally determined values. In trying to improve the agreement, a new approach is proposed. This consists of solving the minimization problem with an energy balance constraint in addition to the mass balance constraints. Comparing the composition computed from this restricted equilibrium calculation with experimental data showed that there was an order of magnitude agreement with the low molecular weight species present. However, the high molecular weight species that were found to be present experimentally were not predicted to be present by the calculations except in trace amounts. Author

N70-24890# Instituto de Energia Atomica, Sao Paulo (Brazil).
SPECTROPHOTOGRAPHIC DETERMINATION OF BORON IN URANIUM, ALUMINUM, AND MAGNESIUM: EXTRACTION OF TETRAFLUOROBORATE WITH MONOMETHYLTHIONINE [DETERMINACAO ESPECTROFOTOMETRICA DE BORO EM URANIO,

ALUMINIO E MAGNESIO: EXTRACAO DE TETRAFLUORBORATO DE MONOMETILTIONINA]

Ludmila Federgruen and Alcidio Abrao Jun. 1968 20 p refs In PORTUGUESE Presented at the 19th Ann. Meeting of Brazilian Soc. for the Progr. of Sci., Rio de Janeiro, Jul. 1967
(IEA-165; CONF-670737-2) Avail: CFSTI

The determination of microquantities of boron in highly pure uranium compounds is done through solvent extraction of the BF4 ion complexed with monomethylthionine (MMT) in 1,2-dichlorethane. Uranium oxide or ammonium diuranate fired to U3O are dissolved with sulfuric acid, and after addition of hydrofluoric acid the blue BF4(-)-MMT complex is extracted in dichlorethane and measured at 640 to 645 mu in 1.0 cm cell. The lowest boron concentration measured in the organic phase was 0.02 ppm. Boron was determined in the 0.2 to 10.0 microgram range, and for the determination of 0.1 ppm B in uranium the maximum error was + or − 15%. Author (NSA)

N70-24899*# Louisiana State Univ., Baton Rouge. Reacting Fluids Lab.

COMPARISON OF METHODS FOR DETERMINING THE COMPOSITION OF PYROLYSIS PRODUCTS FROM THE DEGRADATION OF ABLATIVE COMPOSITES Status Report

Simon Hacker, Gary C. April, Edwardo G. del Valle, and Ralph W. Pike 15 Feb. 1970 42 p refs
(Grant NGL-19-001-059)
(NASA-CR-66929; RFL-9) Avail: CFSTI CSCL 07D

To obtain a representative composition of the pyrolysis products being given off in the decomposition zone from the degrading ablative composite a combination of four methods were used. These were: (1) chemical analysis of the pyrolysis gases reported in the literature, (2) comparison of experimentally measured and calculated heats of pyrolysis, (3) relative strength or weakness of chemical bonds and (4) restricted chemical equilibrium. The results from among these methods for the prediction of the composition of the pyrolysis products are compared. No one of the methods is clearly outstanding, but (1) and (2) are definitely superior to (3) and (4). Combining the results obtained for the four techniques a representative composition is proposed for the pyrolysis products from a nylon (40% weight)-phenolic resin (60% weight) ablative composite. This composition is stochiometrically consistent with the elements present in the virgin plastic, but it is significantly different from the composition that would be predicted from chemical equilibrium due to the presence of high molecular weight carbon ring compounds. Author

N70-24911# National Inst. for Metallurgy, Johannesburg (South Africa). Analytical Chemistry Div.

A RAPID METHOD FOR THE DETERMINATION OF MINOR AMOUNTS OF THORIUM IN AQUEOUS SOLUTIONS OF URANYL NITRATE OR CHLORIDE

E. B. T. Cook and T. W. Steele 31 Jan. 1969 4 p refs
(NIM-460; Rept-90/11) Avail: CFSTI

Thorium is determined spectrophotometrically with Arsenazo 3. Uranium and other interfering elements are separated from the Th by use of an anion exchange resin in the chloride form. The method is suitable for the determination of ThO2 in solutions from 1 ppM upwards, and can be completed within 1 hr. NSA

N70-24923# France. Ministere de l'Air, Paris.

CONTRIBUTION TO THE STUDY OF TRANSPORT OF MATTER IN CONCENTRATED SOLUTION TO AID ELECTROCHEMICAL APPLICATIONS OF A ROTATING DISK [CONTRIBUTION A L'ETUDE DU TRANSPORT DE MATIERE EN SOLUTION CONCENTREE A L'AIDE D'UN DISQUE TOURNANT APPLICATIONS ELECTROCHIMIQUES

Michel Daguenet 1969 62 p refs In FRENCH
(Rept-453) Avail: CFSTI

Calculation of the relationship between the angular velocity of a rotating disk and the diffusion flux bounds of a surface in concentrated solutions under laminar conditions is presented. Density variations, viscosity, and diffusion coefficients along with the concentrations are considered. A description of an electrode disk with a mercury contact is given. The study of the anode dissolving of nickel in concentrated sulfuric solutions, and of aluminum in concentrated solutions of magnesium perchlorate revealed the importance of diffusion. Transl. by J.M.C.

N70-24975# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

PULSE RADIOLYSIS: A COMPREHENSIVE BIBLIOGRAPHY, 1960 TO MARCH 1969

H. Greenshields and W. H. Seddon Jan. 1970 67 p refs
(AECL-3524) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $1.50

A search of abstract and indexing sources for the period 1960 to March 1969 provided most of the material which appears in this bibliography. The references are listed in broad subject groups and are sub-arranged by year, latest publication first. The entries are alphabetically ordered by authors' surname, then by title. Each entry is numbered serially, including the Appendix entries which are arranged in the same subject groups as the main bibliography. The number of the first and last entry on each page is identified to facilitate entry location. An alphabetical author index is supplied for quick reference. Abbreviated titles, sub-arranged alphabetically are incorporated where two or more articles by the same author have been included in the bibliography. All co-authors are referenced so that the total authorship of each included paper can be established. Author

N70-25002 Virginia Polytechnic Inst., Blacksburg.

OPTIMIZED MODEL FOR ISOTHERMAL MULTICOMPONENT MASS TRANSPORT IN AQUEOUS ELECTROLYTIC SOLUTION

Hsi-Sheng Yeh (Ph.D. Thesis) 1969 312 p
Avail: Univ. Microfilms: HC $14.20/Microfilm $4.00 Order No. 69-19991

The systems studied contained sodium, chloride, hydrogen, and nitrate ions, and water 25 C, atmospheric pressure. The diffusion coefficient, electrical conductivity, and transference number were chosen as the rate constants to be studied. Diffusion coefficients for both sodium nitrate and nitric acid, and all of the experimental data for mixed electrolytes were obtained. The diffusion experiments were performed in a diaphragm cell. The electrical conductivity experiments were determined with a Wheatstone bridge circuit. Both the diaphragm cell and the conductivity cell were specially designed. The optimal fractional coefficient values were obtained from the nonlinear expressions by an iterative least squares procedure. The frictional coefficients, the values of various rate constants for an aqueous electrolytic solution can be predicted for either binary or multicomponent systems. The model predicted the rate constants with a maximum deviation in the neighborhood of seven per cent over the concentration range from 0.0N to 1.0N. Dissert. Abstr.

N70-25012# Eidgenossische Technische Hochschule, Zurich (Switzerland).

ELECTRON SPIN RESONANCE SPECTRA OF RADICAL IONS IN NON-ALTERNATING HYDROCARBONS, PART 1. COMPUTER PROGRAM FOR ANALYSIS OF ELECTRON SPIN RESONANCE SPECTRA FROM ORGANIC RADICALS, PART 2 [ESR-SPEKTREN DER RADIKAL-IONEN NICHT-ALTERNIERENDER KOHLENWASSERSTOFFE, TEIL 1. ANALYSE VON ESR-SPEKTREN ORG. RADIKALE MITTELS

COMPUTER-PROGRAMM, TEIL 2]
Josef Peter Heinzer (Ph.D. Thesis) 1968 68 p refs In GERMAN *Its* Diss. No. 4255
Avail: CFSTI

Developed are the basic mathematics of a least squares program for the optimization of experimentally determined electron spin resonance parameters. The program is described and possible applications to radical ion spectra of non-alternating hydrocarbons are outlined. Discrepancies in coupling constants are explained by the MO theory. Transl. by G.G.

N70-25045 Akron Univ., Ohio.
THE INFLUENCE OF CHAIN CONFORMATION ON THE CHEMICAL REACTIVITY OF POLYMERS
Richard Joseph Ambrose (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-17860

In an effort to determine the effect of conformation on the rates of hydrolysis of polymers containing acrylic ester and methacrylic ester units, attempts were made to alter the conformational structures of polymers by mechanical means, and the chemical reactivities of the polymers having altered conformations were investigated. Films of streched and unstretched poly(ethyl acrylate) were hydrolyzed at the same rate, provided that the dimensions of stretched and unstretched film samples were equivalent. The inherent weakness of swollen poly(ethyl acrylate) films limited the magnitude of conformational change that could be induced by stretching, however, so other approaches were investigated. Finally, the first kinetic studies on the homogeneous alkaline hydrolysis of poly(methyl methacrylate) were conducted. Conventional and isotactic poly(methyl methacrylates) were hydrolyzed alkaline dimethyl sulfoxide-cyclohexanol solution. The isotactic polymer was hydrolyzed approximately twice as fast as the conventional polymer, in accord with results obtained by others in heterogeneous hydrolysis systems. However, there was no evidence for autocatalysis, as would be expected for the case where neighboring group interactions play a significant role in the hydrolysis reaction. Dissert. Abstr.

N70-25050 Carnegie-Mellon Univ., Pittsburgh, Pa.
ELECTRODE PHENOMENA AND THERMAL ANALYSIS ASSOCIATED WITH LOW-VOLTAGE TRANSIENT ARCS UNDER LIQUID DIELECTRICS AT SHORT INTERELECTRODE GAP SPACINGS
Walter Thomas Haswell, III (Ph.D. Thesis) 1969 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-19096

The experimental and theoretical conditions correspond to those typically found in electrical discharge machining. The experimental results indicate that a considerable amount of melting and vaporization occurs at the electrodes, and that a large amount of molten metal solidifies and remains on the electrode surface after the discharge. Large scale motion of the discharge column across the electrode surface was found to occur, particularly for plane-parallel electrodes with discharge durations greater than 200 microseconds. A detailed energy balance is presented. Calculations indicate that for a wide range of practical conditions, almost all of the input energy to the discharge must be dissipated by electrode phenomena. The electrodes were modeled using an implicit finite difference simulation technique. Dissert. Abstr.

N70-25080# Pontificia Universidad Nacional Catolica del Peru, Lima.
SYNTHESES AND REACTION OF BIS AND TRIS-BENZYNE Final Technical Report
Gaston Vargas Aug. 1969 14 p refs
(Grant AF AFOSR-1174-66)
(AD-699214; ARL-69-0217) Avail: CFSTI CSCL 7/3

Discussed is a simple preparative way to generate bis-benzyne and prove that the double elimination reaction prior to intermediate formation occurs simultaneously. Author (TAB)

N70-25141# Royal Aircraft Establishment, Farnborough (England).
THE ACTION OF CHEMICAL FACTORS IN MoS2 LUBRICATION [DIE WIRKUNG CHEMISCHER FAKTOREN BEI DER MoS2-SCHMIERUNG]
G. Heinicke et al Oct. 1969 13 p refs Transl. into ENGLISH from Schmierstoffe u Schmierungstech., no. 21, 1967 p 23 30
Avail: CFSTI

Evidence for chemical reaction between MoS2 and metals during mechanical stressing is presented. The technique developed involves vibrating MoS2, silicon carbide, and metals together in a reaction vessel containing CO. The rate of formation of metal (Ni or Fe) carbonyl is used as an indicator for the formation of metal sulphide. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-23934# California Univ., Livermore. Lawrence Radiation Lab.
DETERMINATION OF TRANSFER FUNCTION OF SEISMOMETER-TELEMETRY SYSTEM THROUGH USE OF PSEUDO-RANDOM BINARY SEQUENCES
Deane D. Judd (M.S. Thesis) 16 Jan. 1969 31 p refs
(UCRL-50490) Avail: CFSTI

A technique used in determining the transfer function of a linear system designed at the Lawrence Radiation Laboratory (LRL) to detect vertical earth motion for determining the explosive yield of nuclear tests is described. The system detects the vertical earth motion at a remote site near Mina, Nevada, and telemeters the information to LRL, Livermore, where it is recorded visibly and on magnetic tape. In brief, the system consists of a long-period vertical seismometer with output signal proportional to velocity, a voltage amplifier followed by a band-pass filter, an FM telemetry system, and a stripchart and/or a magnetic tape recorder. The frequency band of interest is 0.001 to 20 Hz. A procedure for determining the system transfer function, with a pseudo-random binary sequence as input signal, is described, and experimental results giving amplitude and phase characteristics are presented. Author (NSA)

N70-23936# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ELECTROMAGNETIC INTERFERENCE MEASUREMENT METHODOLOGY, COMMUNICATION EQUIPMENT Final Report, 1 Feb. 1968 31 May 1969
William R. Free and Charles W. Stuckey Oct. 1969 114 p refs
(Contract DAAB07-68-C-0189)
(AD-696494; GIT-A-1075-F; ECOM-0189-F) Avail: CFSTI CSCL 17/2.1

The report summarizes the accomplishments on a program to develop improved test techniques and procedures for performing radiated measurements in shielded enclosures which can be correlated with measurements made in the open-field. A set of three short hooded probe antennas to cover the 1 to 12 GHz frequency range were developed and evaluated. Results from this program

indicate that reliable radiated measurements, which can be correlated with open-field measurements, can be made in shielded enclosures with short hooded probe antennas over the 200 MHz to 12 GHz frequency range. Coupling nulls were observed in shielded enclosures in the frequency range from 10 to 100 MHz. The presence of these nulls could not be explained on the basis of cavity resonances or multi-path reflections from the enclosure walls since the dimensions on the enclosures were quite small in terms of wavelengths. It was concluded that a different coupling mechanism must be responsible for the existance of these coupling nulls. A theory was developed to explain the nulls in terms of near-field coupling between the radiating source and the enclosure extensive experimental measurements supported the validity of this theory. The coupling nulls were essentially eliminated by isolating the probe antenna from the enclosure walls. Author (TAB)

N70-23939# Mitre Corp., Bedford, Mass. Communications Techniques Dept.

BASEBAND DATA TRANSMISSION USING WIRELINE CABLE

O. Cardinale and W. J. Ciesluk, Jr. Sep. 1969 53 p refs
(Contract F19628-68-C-0365)
(AD-698177; MTD-94; ESD-TR-69-293) Avail: CFSTI CSCL 17/2

The feasibility of using baseband signaling techniques for data transmission over multipair wireline cable plant is examined. The limit of transmission distance over 19 AWG and 22 AWG non-loaded wire pairs is determined by computing the eye patterns for polar NRZ signaling for various data rates. Polar NRZ signaling was implemented and tested on existing wireline data transmission links, and results were compared with theoretical predictions. The results showed that significant transmission distances can be achieved by using simple and inexpensive polar NRZ techniques. Other baseband techniques such as bipolar signaling at described and recommended as candidates for extremely long multipair wireline cable links and/or high data rate transmission. Author (TAB)

N70-24063*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

PHOTON COUNTING: A PROBLEM IN CLASSICAL NOISE THEORY

Sherman Karp and John R. Clark Washington Apr. 1970 31 p refs
(NASA-TR-R-334; C-105) CSCL 17B

Formulated is the general problem of determining the photoelectron "counting" distribution resulting from an electromagnetic field impinging on a quantum detector. The electromagnetic field is assumed to be the sum of a deterministic signal and a zero-mean, narrow-band, gaussian random process, and is expanded in a series of orthogonal functions. Several examples are given. It is shown that all the results obtainable can be written explicitly in terms of the noise covariance function. Particular attention is given to the case of a signal plus white gaussian noise. Various limiting forms of this distribution are derived, including the necessary conditions for those commonly accepted. The likelihood functional is established and is shown to be the product of Laguerre polynomials. For the problem of continuous estimation, the Fisher information kernel is derived and an important limiting form is obtained. The MAP (maximum a posteriori) and ML (maximum likelihood) estimation equations are also derived. In the latter case the results are also functions of Laguerre polynomials. Author

N70-24098# Lincoln Lab., Mass. Inst. of Tech., Lexington.

CONTINUOUS COVERAGE OF THE NORTH POLAR REGION WITH ONLY TWO COMMUNICATIONS SATELLITES

John U. Beusch 4 Sep. 1969 24 p refs
(Contract AF 19(628)-5167)
(AD-698751; TN-1969-44; ESD-TR-69-245) Avail: CFSTI CSCL 17/2.1

The problem of providing continuous coverage of the north polar region with a small number of communications satellites is considered. The system described requires only two satellites to provide both this coverage and coverage of a considerable fraction of the northern hemisphere. Two orbit planes with 63.43 deg inclination, high eccentricity and 24 hour periods are employed. The regions of the earth from which a satellite is continuously visible from terminals with various minimum elevation angles are shown. The regions in which mutual visibility of a satellite by two terminals is guaranteed are shown. A few comments concerning satellite design for this orbit are included. Author (TAB)

N70-24136*# Lincoln Lab., Mass. Inst. of Tech., Lexington.

RADAR STUDIES OF THE MOON Quarterly Progress Report

15 Oct. 1968 8 p
(Contract NAS9-7830)
(NASA-CR-108302; QPR-2) Avail: CFSTI CSCL 17I

The instrumentation of the two-channel radar receiver is presented. Mounting the Planetary Radar (PR) Box, including an operational two-channel receiver, on the 120-foot antenna is scheduled for four weeks planetary observations. Much of that period will be occupied with tests of the dual-channel system. An intensive mapping operation will begin when the PR Box again is mounted on the antenna. The first-phase (real-time) and second-phase (Fourier transform) computer programs have been rewritten to process the multiplexed two-polarization data and produce one pre-mapping tape for each polarization. As a result, the third-phase (mapping) program can be used without change. Author

N70-24144# Institute for Telecommunication Sciences, Boulder, Colo.

PREDICTING LONG-TERM OPERATIONAL PARAMETERS OF HIGH-FREQUENCY SKY-WAVE TELECOMMUNICATION SYSTEMS

Alfred F. Barghausen, James W. Finney, L. Lee Proctor, and Larry D. Schultz May 1969 301 p refs
(ESSA-TR-ERL-110-ITS-78) Avail: SOD $2.25

Methods and computer programs are presented which predict the expected long-term performance of high-frequency telecommunication systems. Emphasis is placed on solution by computer methods of the circuit operational parameters (MUF, FOT, LUF) and on recent improvements in the basic ionospheric and geophysical data. Propagation via the sporadic-E mode is considered as supplementing the regular E-layer mode. Improved techniques for calculating the theoretical patterns and gains of 10 most commonly used HF antennas are included. A method is described that provides short-term estimates of the F2-layer MUF from measured values of the local magnetic index. Application to communication problems is illustrated, based on concepts of circuit reliability and service probability as measures of the expected system performance, including consideration of multipath interference. An annotated listing of the program and descriptions of input data and output are given in the appendices. Author

N70-24170 British Broadcasting Corp., Kingswood (England). Research Dept.

MEDIUM-FREQUENCY SKY-WAVE BROADCASTING: EFFECT OF POLARIZATION ON INTERFERENCE

Mar. 1970 6 p ref
(Rept-1970/7) Avail: CFSTI

Horizontal transmitting aerials may be used at medium frequencies for short-distance broadcasting via the ionosphere. The use of horizontal rather than vertical aerials affects the strength of

interfering signals which propagate at night to greater distances. It is shown that less interference is caused in temperate latitudes when horizontal aerials are used, while in tropical latitudes the level of interference is unlikely to exceed that normally experienced in temperate latitudes. Author

N70-24171 British Broadcasting Corp., Kingswood (England). Research Dept.

AUTOMATIC REGISTRATION FEASIBILITY STUDY: FUNDAMENTAL CONSIDERATIONS

Mar. 1970 10 p refs

(Rept-1970/6) Avail: CFSTI

Problems involved in the design of automatic systems of registration for three-tube and four-tube color TV cameras are described. Particular attention is paid to methods of error detection and correction. It is concluded that any fully comprehensive automatic registration system which might be added to existing cameras would require considerable additional equipment and might involve extensive modification to cameras. Simplified forms of correction in which only some types of registration error are corrected are also discussed. These would be very much simpler and cheaper and might be sufficiently effective. Author

N70-24172# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

EVALUATION OF THE EFFECTIVENESS OF SEVERAL SYSTEMS OF FALSE ALARM STABILIZATION IN THE PRESENCE OF NON-STATIONARY GAUSSIAN NOISE [OTSENKA EFFEKTIVNOSTI NEKOTORYKH SKHEM STABILIZATSII LOZHNOY TREVOGI PRI NESTATSIONARNOM GAUSSOVOM SHUME]

G. A. Utkina et al Dec. 1969 15 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Inst. (Moscow), no. 178, 1968 p 116-126

Prepared for Lincoln Lab., MIT

(AZT-69-664-RULL) Avail: CFSTI

Under conditions of nonstationary disturbance, the phase autocorrelator system is found to be best for stabilizing the false alarm level in multichannel detectors. Author

N70-24191# Naval Research Lab., Washington, D.C.

TRIMMED-MEAN DETECTOR FOR NONCOHERENT DISTRIBUTIONS Interim Report

G. V. Trunk 11 Dec. 1969 17 p refs

(AD-699150; NRL-6997) Avail: CFSTI CSCL 17/9

Sea-clutter measurements using high-resolution radar indicate that clutter cross-section returns do not usually follow a Rayleigh distribution. The log-normal and contaminated-normal descriptions of sea clutter have been considered, and detection curves for these distributions have been generated for both the mean and median detectors - the median being better for the log-normal distribution and the mean being slightly better for the contaminated-normal. In this report, the trimmed-mean detector is proposed as a detector against these clutter distributions. By using a Monte Carlo technique, equations are obtained for the threshold values, and curves of probabilities of detection (P sub d) are drawn for false-alarm probabilities (P sub fa) ranging from 0.01 to 10 to the minus 9th power. When one compares the mean, median, and trimmed-mean detectors, the conclusion is that the trimmed-mean is the better detector against either of the two distributions considered. In fact, for the log-normal distribution, when 10 samples are available, the trimmed-mean requires 5 dB less S/N ratio than the mean in order to obtain P sub d = 0.9 and P sub fa = 10 to the minus 8th power. Unfortunately, whereas the mean and median are easily implemented, the implementation of the trimmed-mean is very difficult because of the necessity of ordering the samples. Author (TAB)

N70-24207# Institute for Telecommunication Sciences, Boulder, Colo.

ANALYSIS OF PROPAGATION MEASUREMENTS OVER IRREGULAR TERRAIN IN THE 76 TO 9200 MHz RANGE, PART 1 Final Report

A. P. Barsis, M. E. Johnson, and M. J. Miles Mar. 1969 137 p refs

(Contract F04701-68-F-0072)

(AD-699072; ESSA-TR-ERL-114-ITS-82; SAMSO-TR-69-325) Avail: SOD $1.25; CFSTI CSCL 17/2.1

Descriptive and statistical analyses of radio propagation data over irregular terrain in approximately the 100-to-10,000 MHz frequency range are presented, with special emphasis on communications between low antennas in the 225-to-400 MHz band. Data are evaluated in terms of medians and ranges of basic transmission loss, height gain, frequency dependence and effects of vegetation. Graphs provide first estimates of these parameters for specific applications in many terrain types. The results also provide information for verification and improvement of previously developed more general propagation models. Author (TAB)

N70-24219# Wisconsin Univ., Madison. Mathematics Research Center.

WAVE PROPAGATION IN A LINEAR COSSERAT CONTINUUM

George Eason Aug. 1969 38 p refs

(Contract DA-31-124-ARO(D)-462)

(AD-699002; MRC-TSR-985) Avail: CFSTI CSCL 15/3.1

The equations relevant to wave propagation in a linear Cosserat continuum are reviewed and the possible plane wave solutions of these equations are considered. The various types of surface wave which may propagate are then discussed. Author (TAB)

N70-24239# Stanford Univ., Calif. Stanford Electronics Lab.

A PREDICTION MODEL FOR MULTIPATH PROPAGATION OF PULSE SIGNALS AT VHF AND UHF OVER IRREGULAR TERRAIN Technical Report

Hermann F. Schmid Oct. 1969 29 p refs

(Contract DAHC04-67-C-0032)

(AD-699421; SU-SEL-69-071; TR-2401) Avail: CFSTI CSCL 17/2

A prediction model is presented that permits calculation of the probability of occurrence of distinct multipath propagation of pulse signals at VHF and UHF over irregular terrain. The model applies to terrain characterized by an irregular distribution of obstacles such as hills, buildings, trees, etc., so as to make it impractical to calculate the effect of multipath propagation by diffraction or bistatic-reflection theory. Statistical data on wave propagation over irregular terrain form the basis for the empirical model developed. Generally, the model predicts that (1) for constant transmitter-to-receiver separation, the amplitudes of the received echoes decrease with increasing echo delay, and (2) for constant echo delay, the occurrence of echo pulses increases as the transmitter-to-receiver distance increases. The results obtained from the model for rural, hilly terrain and for a built-up metropolitan area are compared with available measured data. Author (TAB)

N70-24241 Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo. Research Lab.

EXPERIMENTAL VERIFICATION OF AN IONOSPHERIC CHANNEL MODEL Technical Report

C. C. Watterson, J. R. Juroshek, and W. D. Bensema Jul. 1969 100 p

(AD-699486; ESSA-TR-FRL-112-ITS-80) Avail: CFSTI CSCL 17/2

Specially designed ionospheric propagation measurements

were made and analyzed to confirm the validity and accuracy of a proposed ionospheric communication channel model. This stationary channel model incorporates a delay line that is fed by the input (transmitted) signal. Several adjustable taps on the delay line deliver signals with delays corresponding to the relative propagation times of typical ionospheric modes. Each delayed signal is modulated in amplitude and phase by an independent baseband complex bivariate Gaussian random function of time with a zero mean value and quadrature components with equal RMS values that produce Rayleigh fading. Ionospheric measurements were made in 12-kHz bands at two HF frequencies over a 1294-km path. Three samples of 10- to 13-min duration were analyzed for typical daytime and nighttime propagation conditions. Author (TAB)

N70-24243# Institute for Telecommunication Sciences and Aeronomy, Boulder, Colo. Research Lab.

RECOMMENDED SPECIFICATIONS FOR IONOSPHERIC CHANNEL AND ATMOSPHERIC NOISE SIMULATORS Technical Report

C. C. Watterson and R. M. Coon Sep. 1969 27 p refs

(AD-699487; ESSA-TR-ERL-127-ITS-89) Avail: CFSTI CSCL 17/2

The many advantages in the use of ionospheric simulators in laboratory experiments with communication systems over similar on-the-air tests are discussed. Descriptions are given of an ionospheric channel model and an atmospheric noise model whose validities and accuracies were previously experimentally verified at high frequencies. Recommended numerical specifications are presented for ionospheric channel simulators and atmospheric noise simulators based on the verified models. Author (TAB)

N70-24261# Page Communications Engineers, Inc., Washington, D.C.

FREQUENCY DIVISION MULTIPLEX, RADC TROPOSCATTER TEST PROGRAM Final Technical Report

Griffiss AFB, N.Y. RADC Oct. 1969 389 p refs

(Contract AF 30(602)-4197)

(AD-696179; RADC-TR-68-22; R-4132-99-0044) Avail: CFSTI CSCL 17/2.1

Over-the-air tests were conducted to determine the performance which can be expected from transmitting 2.4 kb/s and 38.4 kb/s digital data thru voice and group channels of an FM/FDM tropo-scatter communications system. The tests were performed on path lengths of 100, 200 and 400 miles in New York State and in the Carribean area. The basic transmission system was the AN/MRC-98 Radio Set configured for 24 and 120 voice channel capacities. The 2.4 kb/s and 38.4 kb/s modems were of the duo-binary and DCPSK type. The modem performance, in terms of bit error rate, is presented as a function of received carrier power, channel signal-to-noise ratio, order of diversity, system channel capacity, and predicted path intermodulation noise. Author (TAB)

N70-24273*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

TECHNIQUES FOR ELIMINATING BASEBAND VOICE INTERFERENCE WITH TELEMETRY FOR THE APOLLO COMMUNICATION SYSTEM

G. Dickey Arndt, Sidney W. Novosad, and Robert J. Panneton Washington Apr. 1970 95 p refs

(NASA-TR-R-337; S-228) Avail: CFSTI CSCL 17B

Excessive telemetry error rates caused by baseband voice interference occur in several modes of the Apollo communication system. Demodulation, using essentially nonlinear quadrature phase detection, causes voice terms to appear in the telemetry spectrum. In this report, two methods which effectively linearize the demodulation process are used to reduce the voice interference. One method uses a negative feedback loop incorporated around the present nonlinear phase detector. The other method uses a frequency-modulation demodulator preceded by a composite filter containing three band-pass filters in parallel. The theoretical development, construction, and testing of both methods are presented. Significant improvement in telemetry performance is obtained. Results show that voice interference to both the 1.8- and 51.2-kbps telemetry data is negligible for all spacecraft/ground-station conditions when using either of the two methods. It is recommended that the negative-feedback-loop method be implemented in the Manned Space Flight Network ground stations as a result of its relative simplicity and superior performance. Author

N70-24289# Michigan Univ., Ann Arbor. Inst. of Science and Technology.

REPORT OF PROJECT MICHIGAN SECTION ON 6A; AN INVESTIGATION OF FACTORS AFFECTING SOUND RANGING LITERATURE SEARCH AND ANALYSIS Quarterly Progress Report, 1 Jan. – 31 Mar. 1969

Sep. 1969 36 p refs

(Contracts DA-28-043-AMC-00013(E); DA-36-039-SC-78801)

(AD-698565; Rept-6400-199-P; ECOM-00013-199) Avail: CFSTI CSCL 17/1

Topics discussed are the progress in compiling the sound-ranging library, the effect of temperature and other meteorological parameters on sound propagation, the details of artillery signatures, sound location by hyperbolic fixing, the accuracy of artillery return fire, the influence of terrain on sound ranging, and plans for the next quarter. Author (TAB)

N70-24291# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

SYNTHESIS OF PULSE SIGNALS WITH GOOD PROPERTIES OF THE UNCERTAINTY FUNCTION, PARTS 1 AND 2 [O SINTEZE IMPUL'SNYKH SIGNALOV S KHOROSHIMI SVOYSTVAMI FUNKTSII NEOPREDELENNOSTI]

A. F. Terpugov et al Jan. 1970 27 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (USSR), v. 12, no. 2, 1969 p 157 – 173 Prepared for Lincoln Lab., MIT

(AZT-70-39-RULL) Avail: CFSTI

A two-stage method for the synthesis of pulsed radar signals whose uncertainty function has a principle maximum and a relatively small level of secondary maxima is presented. The first stage involves the synthesis of signals whose shapes insure minimum error in the estimate of the unknown parameter, taking into account only the principle maximum of the uncertainty function. This class of signals is expanded during the second stage of the synthesis and those signals are selected which have a small level of secondary maxima in the uncertainty function. Several types of signals are described which are useful for radar stations and wideband communications systems. The shape of the uncertainty function for these signals is analyzed. Author

N70-24297*# TRW System Group, Redondo Beach, Calif. Electronics Systems Lab.

LUNAR FAR SIDE COMMUNICATIONS COVERAGE AND VISIBILITY ANALYSIS FOR SATELLITE RELAY SYSTEMS Technical Report

G. W. Breland 5 Feb. 1970 48 p refs

(Contract NAS9-8166)

(NASA-CR-108327; TRW-11176-H462-R0-00) Avail: CFSTI CSCL 17B

The coverage and visibility analysis for lunar orbiting communications satellites is documented. This study is a part of an overall system study for a lunar far side satellite relay communications system. The study program encompasses three tasks: (1) communications system parametric analysis; (2) trajectory

and vehicle considerations; and (3) survey of applicable technology. The communications system parametric analysis is based upon a mathematical model of a satellite communications system. Requirements for relay satellite system parameters such as effective radiated power, noise, temperature, etc., are being investigated for three types of lunar terminal: current Apollo systems, improved Apollo systems, and new communications terminals. Trajectory and vehicle considerations include performance, trajectory, and guidance analysis which encompass, but are not limited to, the following major items: Delta V requirements for entering selected lunar orbits, payload capabilities of candidate launch vehicles, perturbative effects on selected lunar orbits, propulsion requirements for orbit stabilization, and methods of deploying multiple satellites from a single launch vehicle. The survey of applicable communications satellite technology is directed toward an assessment of the current state-of-the-art in the major system such as tracking antenna design, RF power capabilities, and reliability, etc. Author

N70-24315# Institute for Telecommunication Sciences, Boulder, Colo.

TERRAIN EFFECTS ON ANTENNA RADIATION PATTERNS. PART 2: ANALYSIS OF SCATTERED FIELDS

R. H. Ott and J. E. Herman Apr. 1969 91 p refs
(ESSA-TR-ERL-109-ITS-77) Avail: SOD $1.00

A numerical method for calculating the scattering and diffraction at an antenna site to be used in a sky-wave communication link is derived. The method of physical optics is used to treat the scattering by the terrain surrounding the antenna site. The terrain is represented by a Gaussian transformation and, as an intermediate step, the reflection points on the terrain are found. The method is compared with the approach based on the numerical solution of an integral equation and good agreement is obtained. It appears that the method will be applicable over the HF range for the majority of terrain encountered in practice. Author

N70-24317# Bolt, Beranek, and Newmann, Inc., Cambridge, Mass.

CHARACTERIZATION OF STOCHASTIC TRANSMISSION CHANNELS FOR TRANSIENT INPUTS Final Report

William D. Mark 17 Dec. 1969 55 p refs
(Contract N70024-69-C-0155)
(AD-699207; BBN-1917) Avail: CFSTI CSCL 9/4

A new method is presented for characterization of stochastic transmission channels. Transfer relations for the new characterizations are derived. Methods are developed for generating the characterizations from empirically determined waveforms. Series expansions of the expected instantaneous response power are derived in terms of the new characterizations. Author (TAB)

N70-24338*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE BENDING OF A RAY THROUGH A SPHERICALLY SYMMETRIC ATMOSPHERE

Harvey G. Safren Nov. 1969 83 p refs Submitted for publication
(NASA-TM-X-63867; X-643-69-425) Avail: CFSTI CSCL 20N

An equation is derived which explicitly gives the path of a ray through a spherically symmetric atmosphere. The refraction of the ray is assumed to be governed by the laws of geometric optics. The equation involves the arrival angle of the ray at the ground; this angle is obtained by solving an auxiliary equation. The latter equation is not explicitly solvable, but approximate solution formulas are obtained and a numerical solution method is described. Some of the approximate formulas are shown to be accurate to better than one percent down to elevation angles of ten degrees or less. The refractivity profile includes both the troposphere and ionosphere, and is arbitrary within a very large class of functions. Author

N70-24341# Institute for Telecommunication Sciences, Boulder, Colo.

COMPUTER ROUTINES FOR SYNTHESIZING GROUND BACKSCATTER FROM THREE-DIMENSIONAL RAYSETS

Judith J. Stephenson and T. M. Georges Jul. 1969 112 p refs
(ESSA-TR-ERL-120-ITS-84) Avail: SOD $1.00

Digital computer routines in Fortran are described that synthesize artificial ground backscatter displays from raysets, the punched card output of a three dimensional ionospheric radio ray-tracing program. Sample displays in the elevation-azimuth, range elevation, range-azimuth, sweep-frequency, and range time modes are shown, along with some additional displays that are useful in interpreting backscatter data. A routine for plotting intensity gradations on a cathode ray tube display unit is also described. Author

N70-24346 Pennsylvania Univ., Philadelphia.

CRITERIA FOR RADAR SYSTEM DESIGN BASED ON ORTHONORMAL FUNCTION EXPANSIONS OF THE TARGET IMPULSE RESPONSE

Edward Lawrence Frost (Ph.D. Thesis) 1969 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-21352

The response of a fixed or slowly moving radar target to an impulsive plane wave is considered and an expansion of the response waveform in an orthonormal series investigated as a basis for the design of a radar system. General criteria for such a design are set forth for a radar system which provides an estimate of the target impule response characterization parameters by mean-square-estimation of the expansion coefficients during a finite observation time. The mean-square-errors are summed and are further minimized subject to the constraint that there is a limited amount of transmitted energy available. The minimization procedure is carried out in the frequency domain based on the assumption that the target and noise processes are at least locally stationary during the observation interval. The analytical results are applied to the problem of radar system design and verified by computer simulation. A white noise environment is assumed and a flat average power spectrum postulated for the target ensemble. In general, the estimation error decreases as the signal-to-noise ratio at the receiver increases and perfect estimates are achieved for the zero noise case. Dissert. Abstr.

N70-24393 Georgia Inst. of Tech., Atlanta.

ESTIMATION OF DISCRETE SIGNALS CONTAINING A NONRANDOM COMPONENT

Norman Dale Crump (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-19789

A detailed discussion of the Kalman estimator is given, with emphasis on the sensitivity of the estimates to errors in the model of the nonrandom characteristic of the signal. The fixed memory estimator computes estimates based on data obtained over a fixed length of time immediately preceding the most recent measurement. A new estimation technique, called the augmented memory estimator, is formulated with the objective of computing estimates which are relatively insensitive to errors in the signal dynamical model while making use of all available data. The mean square error and the sensitivity properties of the augmented memory estimator are illustrated by digital computer simulations. Linear models for nonlinear signals are included in the examples. Dissert. Abstr.

N70-24395# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

THE INFLUENCE OF NOISE CORRELATION ON THE EFFICIENCY OF MATCHED FILTER PERFORMANCE

J. C. Dunn Mar. 1970 50 p refs

(RE-375) Avail: CFSTI

The problem of finding optimum linear filters to detect the presence of known signals in a noisy environment is reinvestigated. A detailed comparison is made between the true optimum filter and one that would be optimum if the noise were uncorrelated; the latter usually referred to as a matched filter. The major conclusion is that whenever any degree of correlation is present in the noise then for certain signals, the performance of the optimum filter is infinitely greater than the performance of a matched filter designed for the same signal. The discussion includes a treatment of both one dimensional and two dimensional signals, the latter being of considerable interest in the area of optical systems, particularly for certain proposed applications in photointerpretation systems. An abstract mathematical formulation and treatment of the problem, and a concrete or constructive discussion of certain classes of signals and noise environments that would seem to be relevant in many areas of application are presented. Author

N70-24416# Illinois Univ., Urbana. Coordinated Sciences Lab.
SOME ASPECTS OF DATA COMPRESSION SYSTEMS
Sam Guccione Dec. 1969 43 p refs
(Contract DAAB07-67-C-0199)
(AD-699355; R-448) Avail: CFSTI CSCL 17/2

Three data compression systems were analyzed and compared in terms of their bit rate and sampling error. The quantization error was not included in the system analyses since it was the same for all the systems due to the type of signals considered. The conventional data system was included as a comparison for the compression systems. The non-uniform sampling system was shown to be an ideal system with no error. The rate of this system is the lowest rate required to achieve no sampling error. The sample elimination method, a redundancy reduction system, was compared to the quantization of amplitude and time system, a form of run-length encoding. The analyses presented are an attempt to further the study of data compression techniques. Other work needed in this area includes computing error curves to facilitate selecting an optimum bit rate with minimum error. Author (TAB)

N70-24443 Pennsylvania Univ., Philadelphia.
A COMPARATIVE STUDY OF COHERENT PHASE SHIFT KEYING AND NON-COHERENT FREQUENCY SHIFT KEYING IN A MULTIPATH ENVIRONMENT
James Carroll Blair, II (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-21326

The performance of two fundamental digital communication systems in a specific multipath environment is determined. The communication channel consists of the link between two orbital vehicles communicating over a rough, planetary surface. The resultant received signal consists of a component from the direct link, plus a component from the multipath link, i.e., a component scattered off the planetary surface. The multipath signal carries information about the modulating signal provided that the multipath fading is frequency nonselective, which is an assumption maintained throughout the dissertation. The receiver may use this information to advantage in the detection process provided that certain conditions are met. These conditions are the following: (1) There must be a very small propagation delay between the direct and multipath links; (2) The phase shift keyed receiver is able to remain coherent. This implies an ability to track the carrier phase angle of the resultant received signal; (3) The fading process may be considered to be frequency nonselective; and (4) An adequate bit synchronization signal may be derived within the receiver. Dissert. Abstr.

N70-24488 Houston Univ., Tex.
SCALAR WAVE SCATTERING BY RANDOM SEMICYLINDRICAL BOSSES
William Anton Klos (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-21757

The theoretical and experimental study of the total acoustic field reradiated from two quasi-rigid model surfaces emersed in a water medium was undertaken. These models consisted of periodic arrays of circular semicylindrical bosses with either constant or random radii on a plane surface. The radii of these bosses were large compared to the wavelength of a 7 MHz incident field, and the separation between bosses was taken to be large in order to reduce multiple reflections. The model surfaces were machined from 3/8 inch thick aluminum plate. The selection of the size of the radii, separation distances between bosses and number of illuminated bosses, was based on a compromise to obtain the best approximation to a plane incident wave over the target. The total field reradiated from these models was calculated using the Kirchhoff method of physical acoustics. Dissert. Abstr.

N70-24483# Bell Aerosystems Co., Buffalo, N.Y.
LEARNING OF UNKNOWN PROBABILITY DENSITY FUNCTIONS FOR PATTERN CLASSIFICATION
Lester A. Gerhardt, Johannes G. Goerner, Kenneth W. Drake, and James A. Cadzow Nov. 1969 69 p refs
(Contract AF49(628)-1627)
(AD-699238; AFOSR-70-0066TR; Rept-9500-920165) Avail: CFSTI CSCL 9/4

A nonprobabilistic discrete iterative procedure for directly estimating a piecewise linear decision boundary is described. Cascaded linear thresholded networks are used to form the boundary which is based on a minimum probability of error of classification. An algorithm for adjusting the variables of an additional linear threshold network is developed such that a maximum number of additional input patterns may be correctly classified using the newly added network. The main part of the report is concerned with developing algorithmic procedures for estimating the shape of the probability density function of an input pattern class. Two classes of algorithms are derived. Both divide the variable range into bins and provide adjustments of the boundaries to attain equiprobable bins. The first class of algorithms are heuristically derived. The second class results from maximizing the entropy of the estimate as an index of performance, using a steepest ascent rule. General convergence properties of LMSE algorithms, when used with probabilistically defined inputs are described. Applications covered include adaptive signal estimation, adaptive signal noise ratio enhancement, and spectral discrimination. Author (TAB)

N70-24487# Miami Univ., Fla.
PROCEEDINGS OF UNIVERSITY OF MIAMI SYMPOSIUM ON OPTICAL PROPERTIES OF ORBITING SATELLITES
Final Technical Report
Douglas Duke and Kenneth E. Kissell, eds. Wright-Patterson AFB ARL May 1969 189 p refs Conf. held at Miami, Fla., Dec. 1967
(Contract F33615-67-C-1870)
(AD-692742; ARL-69-0078) Avail: CFSTI CSCL 17/8

Contents: Ten years of optical satellite observations; Optical and infrared characteristics of satellite surface materials; Reflectometer experiment; The determination of the orientation of a tumbling cylinder from the shape of the light curve; Time varying reflection from rotating convex surfaces; Interpretation of photometric signatures from satellites; Investigations into a method for the optical estimation of the rotation axis of artificial satellites; Optical studies of spacecraft from the cloudcroft facility; The design and operation of some devices for photoelectric and photographic registration of artificial satellites; Results of photometric and polarimetric measurements for various satellites using NASAs mobile photometric observatory; An approximate method of estimating the reflection characteristics of a spherical satellite; Design of telescope optical systems for visual observations of orbiting satellites; Theory and

observation of the rotational motion of the Pegasus satellites; Attitude determination of the Ariel III satelitte; Czechoslovak contribution to satellite photometry; and Wide band (visual spectrum) photoelectric photometry of PAGEOS during its first fifteen months in orbit. TAB

N70-24488 Montana State Univ., Missoula.
HUYGENS' PRINCIPLE APPLIED TO THE CYLINDRICAL ANTENNA BOUNDARY VALUE PROGRAM
Orville Kenneth Nyhus (Ph.D. Thesis) 1969 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-20126

The application of Huygens' principle to the cylindrical antenna boundary value problem is considered. The research described herein yields an explicit expression for the impedance of a cylindrical antenna. The principles involved in applying the mathematical form of Huygens' principle to the cylindrical antenna boundary value problem are presented. A Green's function is derived which satisfies the conditions required by the mathematical form of Huygens' principle. Two forms of Green's function are obtained. Expressions for the current distribution and impedance of the cylindrical antenna are obtained. Numerical results are presented and compared with published measured data and with other theoretical results. The numerical results demonstrate that the impedance characteristics of a cylindrical antenna are correctly described through the application of Huygens' principle. Dissert. Abstr.

N70-24489 Polytechnic Inst. of Brooklyn, N.Y.
VISUAL TO AUDIO TRANSLATION
Leslie Mark Orloff (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-20354

The investigation, design and development of an effective and basically direct method of converting two dimensional patterns, primarily printed letters and numerals, into sound patterns which can be recognized by a human listener is considered. The method is applicable to the reading of printed material which may appear in any of a large variety of sizes, styles or fonts. The areas of concern are: Sensing the printed material; Processing of the input information; Determination of an audio output code; and the correspondence between the audio code and the processed information. The two dimensional pattern is sensed by a linear columnar array of sensors which are scanned across the pattern at a constant rate. The voltage output of each sensor is sampled at intervals to provide a sequence of output voltages from each sensor of the array. With m samples of each sensor and n sensors, there are m x n resolution elements describing the pattern. Dissert. Abstr.

N70-24493 Kansas Univ., Lawrence.
THE TRANSIENT ANALYSIS OF COAXIAL CABLES AT LOW-TEMPERATURE CONSIDERING ANOMALOUS AND CLASSICAL SKIN EFFECTS WITH THE INCLUSION OF ELECTRONIC RELAXATION PHENOMENA
James Edward Rathke (Ph.D. Thesis) 1969 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-21571

Generalized transmission line equations are developed which utilize frequency and temperature dependent dielectric function and metallic surface impedance data. Formulae are developed for the bounding frequencies of the classical skin effect, anomalous skin effect, and extreme relaxation regions. Also, a procedure for finding the frequency and step responses of a transmission line having a spatial temperature variation is developed. It is shown that some errors exist in the formulae for finding the surface impedances of metals in the anomalous range, and a correction technique to reduce these errors is introduced. Surface impedance data on seven metals (Ag, Al, Au, Cu, Pb, Nb and Sn) are tabulated. Also presented are predicted frequency and time domain responses vs temperature (4 K to 300 K) of six commercial miniature coaxial cables. The results generally show that for TEM mode propagation the upper frequency limitation and time domain dispersion decrease with decreasing temperature. Dissert. Abstr.

N70-24500*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEODETIC EARTH ORBITING SATELLITE (GEOS-C), APPLICATIONS TECHNOLOGY SATELLITE (ATS-F) TRACKING EXPERIMENT
Theodore L. Felsentreger, Thomas J. Grenchik, and Paul E. Schmid Mar. 1970 89 p refs
(NASA-TM-X-63872; X-552-70-99) Avail: CFSTI CSCL 22B

The objectives, significance, and disciplinary relationships of the tracking experiment are outlined. Systems and procedures involved in the analysis of tracking data are described along with hardware and operational requirements. The scientific and technical goals of the experiment include: (1) The obtaining of more precise information about the value of satellite-to-satellite tracking for geodesy. (2) The precise evaluation of the orbit determination techniques involving the tracking of a near earth satellite from a synchronous satellite. (3) The conducting of intercomparison experiments involving the satellite-to-satellite tracking system and other systems. (4) The evaluation and use of the satellite-to-satellite tracking capability and the radar altimeter capability for the purpose of conducting earth physics and oceanographic studies. D.L.G.

N70-24509 Pennsylvania Univ., Philadelphia.
SELF-INTERFERENCE IN A PULSE COMMUNICATION SYSTEM
Ronald William Pulleyblank (Ph.D. Thesis) 1969 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-21418

The problem of self-interference in a pulse communication system is considered. It is assumed that the amplitude and arrival time of the desired pulse is known but that its phase is not. The noise in the system is assumed to be of two types: (1) independent interfering pulses from other transmitters in the system for which Poisson arrival time distributions, Rayleigh distributions, uniform phase distributions and identical envelopes are assumed, and (2) bandlimited white Gaussian noise. The Bayes' detector operating on samples taken from within the interval in which the pulse is expected is derived, approximations to this receiver are discussed and a bound on its performance are found. An adaptive receiver operating on samples taken from the interval in which the desired pulse is expected and the two adjacent intervals to it are also examined. Its relationship to the Bayes' detector is examined and a particular design is considered. Dissert. Abstr.

N70-24512# Kansas Univ., Lawrence. Remote Sensing Lab.
THE RANGE ERROR STATISTICS OF A SATELLITE RADAR ALTIMETER
Han L. Lee Sep. 1969 205 p refs
(Contract N62306-67-C-0044)
(AD-699186; CRES-TR-112-2) Avail: CFSTI CSCL 17/9

A radar altimeter with one meter accuracy has been proposed for a geodetic and oceanographic satellite to measure the mean level of the surface. It is reported by Pierson that an altimeter with such an accuracy could detect (a) intermediate and smaller scale geoid features, (b) local sea surface slopes due to strong ocean current, (c) tides storm surges and tsunamis, and (d) mean sea level. Existing techniques for measuring time delay in electronic circuits are more accurate than required in the proposed system, so the primary errors are those associated with the signal fading

caused by scattering from extended targets such as the oceans surface and by the biasing effects caused by the variations in sea state. Author (TAB)

N70-24588# Drexel Inst. of Tech., Philadelphia, Pa.
STUDIES IN ELECTROMAGNETIC SCATTERING FROM TURBULENT WAKES
John Jarem 1969 101 p refs
(Contract DAHC04-67-C-0072; ARPA Order 1009)
(AD-699416; DIT-349; AROD-7471-2-E) Avail: CFSTI CSCL 20/14

Contents: General formulation for the scattering of electromagnetic waves from a non-homogeneous under-dense turbulent wake; Second Born direct and cross polarization incoherent radar cross sections; Second Born scattering model for the SRI turbulent jet; Doppler scattering from an over-dense non-uniform turbulent layer; and Bounds on scalar multiple scattered power. TAB

N70-24591# Harry Diamond Labs., Washington, D.C.
SELECTED DIGITAL HIGH PASS FILTERS
James S. Shreve Oct. 1969 53 p refs
(AD-699346; HDL-TR-1462) Avail: CFSTI CSCL 9/5

A number of simple digital high-pass filters suitable for application, such as digital MTI, are investigated. These filters notch out a band of frequencies at dc and at multiples of the sampling rate. Design methods for recursive and nonrecursive types are presented. Data on numerous examples of filters of various notch widths are tabulated. Author (TAB)

N70-24615 Polytechnic Inst. of Brooklyn, N.Y.
ELECTROMAGNETIC WAVE PROPAGATION CHARACTERISTICS OF PERIODIC STRUCTURES WITH SCREW SYMMETRY
Ming Hui Chen (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-20322

A generalized Floquet's theorem for screw symmetrical structures is found and is proven analytically by using the equivalent network representation of the closed waveguide structure. The sample structures are a periodic stack of parallel unidirectionally conducting screens, a periodic stack of parallel strip gratings, closed cylindrical waveguides perodically loaded with small conducting obstacles and slotted coaxial line. The calculated dispersion curves of the sample structures show good agreement with the Brillouin diagrams predicted from the generalized Floquet's theorem. Several experiments have been conducted on the circular and coaxial waveguide structures. The reflection coefficient and VSWR measurement for stop band identification agree well with the theory. A prediction of the beam direction of the leaky wave structure from the real part of the wavenumber has been verified by measurement of the radiation pattern. Four appendices dealing with radial waveguide modes and discontinuities in radial waveguide are also included. Dissert. Abstr.

N70-24629# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Science and Technology Div.
LASL RADIO COMMAND SYSTEM, TYPE SY-199: TECHNICAL MANUAL
William J. Finneran and John Stanely 27 Jun. 1969 27 p
(Contract AT(29-1)-1183)
(EGG-1183-507; B-4041) Avail: CFSTI

The need for expanded command signalling capability, ac/dc operation with a longer lasting battery complex, for improved frequency selectivity in the band outside the desired range, and for other considerations led to the development of the new LASL Radio Command System, Type SY-199. During the development phase, consideration was given to (1) making the new system compatible with the old, (2) ameliorating the phase-in/phase-out problems, (3) increasing the battery life of the receivers to extend its operating life in the field, (4) expanding the library of commands from 12 to 40 to enable servicing of more experimenters, and (5)maintaining the cost at a minimum consistent with the increased flexibility. Additional features include monitoring of the transmissions, recording the execution of the commands at the remote station, and employing nickel-cadmium batteries to reduce the size and weight of the battery pack. Author (NSA)

N70-24711 Colorado Univ., Boulder.
MAXIMAL CODES WITH SPECIFIED MINIMUM DISTANCE
Arvindkumar Motibhai Patel (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19563

The notion of minimum Hamming distance is the central concept in designing fixed length error correcting codes for a binary communication channel with symmetric error probability. The minimum distance of a code provides a reasonable measure of the error detecting and correcting capability of a code. Maximal codes are fixed length binary codes with the maximum number of n-digit code points and a specified minimum distance d. A maximal code offers the highest transmission rate among the class of fixed length codes with a specified error detecting and correcting capability. The procedure for the construction of these codes from Hadamard matrices is illustrated by examples. It is shown that these codes meet the Plotkin upper limit. Two important classes of maximal codes are defined and studied in detail: maximum uniform distance codes, in which the Hamming distance between any two code points is equal to d and is maximum; and quasi-maximum uniform distance codes, in which the Hamming distance between any two code points is equal to either d or d + 1 and is maximum. Dissert. Abstr.

N70-24719# Institute for Telecommunication Sciences, Boulder, Colo.
UHF PROPAGATION MEASUREMENTS FROM ELEVATED TO BURIED ANTENNAS Final Report, 1 Jul. -31 Dec. 1969
F. G. Kimmett, L. G. Hause, and P. L. Mc Quate Dec. 1969 37 p refs
(Contract F04701-68-F-0072)
(AD-699209; ITS-210; SAMSO-TR-69-410) Avail: CFSTI CSCL 20/14

The report describes many of the UHF propagation characteristics between aircraft or satellites and buried antennas. A vertical monopole was used as a reference antenna, and the propagation characteristics of an annular slot and other antennas, omnidirectional in azimuth, were measured. The effects of reflecting planes used in conjunction with buried elementary antennas were measured. Site power gain patterns were measured from the buried antenna site at elevation angles up to 70 degrees. These tests were made over a reasonably smooth plane, on paths of 0.03, 0.06, and 1 km, and at various transmitting antenna heights, with a helium filled balloon. In some of the tests security fences were used. Author (TAB)

N70-24748# Naval Aerospace Medical Inst., Pensacola, Fla.
IN-FLIGHT MANIKIN RECORDINGS FOR EVALUATING THE COMMUNICATION EFFECTIVENESS OF FLIGHT HELMETS
Carl E. Williams, John R. Forstall, and James W. Greene 23 Jul 1969 24 p refs
(AD-694947; NAMI-1085; NAVMED-MF-12.524.005.5020D-2)
Avail: CFSTI CSCL 9/1

An exploratory study has been conducted to determine

the feasibility of obtaining and using in-flight manikin recordings to evaluate flight helmets with respect to speech intelligibility. Intelligibility test materials were transmitted to six airborne subjects and a manikin as each was fitted with different flight helmets. Similar test materials were presented to the same six subjects in a simulated flight situation. Recordings obtained via the airborne manikin were subsequently placed back in the laboratory to the six subjects and two groups of ten listeners each. Author (TAB)

N70-24763*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORRELATION ANALYSIS AND SCINTILLATION FOR 15-GHz LINE-OF-SIGHT PROPAGATION CHANNELS
E. Mondre Washington Apr. 1970 16 p refs
(NASA-TN-D-5613) Avail: CFSTI CSCL 20N

Experiments have been carried out to measure the temporal nature of amplitude fluctuations under various weather conditions observed on a 15-GHz line-of-sight propagation channel. The path length is on the same order as the atmospherically influenced portion of an earth-spacecraft link which will allow direct comparison with data to be obtained from the ATS-E Millimeter Wave Propagation Experiment. Mean value, mean square value, and statistics of amplitude fluctuations are computed. It is concluded that a Rician distribution is adequate to describe the amplitude data. Channel correlation analysis is discussed. The computed echo correlation functions and echo powder spectral densities indicate a channel coherence time of 1.5 to 4 seconds and a fading bandwidth of less than 0.4 Hz. Magnitudes and spectral densities of amplitude scintillations are calculated from the experimental data and compared with theoretical results derived from the turbulence of the atmosphere. Author

N70-24769*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A THEORETICAL INVESTIGATION OF ELECTROMAGNETIC WAVES OBLIQUELY INCIDENT UPON A PLASMA SLAB
Calvin T. Swift Washington Apr. 1970 56 p refs
(NASA-TR-R-339; L-6938) Avail: CFSTI CSCL 20I

The problem of an electromagnetic wave obliquely incident upon a plasma slab is considered as a boundary-value problem by use of a self-consistent solution of the coupled linearized Vlasov and Maxwell equations. Power reflection, transmission, and absorption coefficients are derived under the assumption that all particles undergo specular reflection at the surfaces of the plasma slab. Although the analysis is valid for arbitrary slab thickness, computational results are presented for slabs which are thin when compared with a wavelength. The results show that a series of resonances occur which are attributed to the finite temperature of the plasma. The results further show that the resonances are Landau damped as the thermal velocity of the plasma electrons increases. It is shown that similar resonances can be predicted from the coupled linearized hydrodynamic Maxwell equations; however, as is well known, such a model does not predict Landau damping. The effects of a finite collision frequency are then included by means of a simple Bhatnagar–Gross–Krook (BGK) collision term. The numerical computations vividly indicate that the resonances undergo severe damping for extremely small ratios of the collision frequency to the signal frequency. Finally, the plasma capacitor problem is considered, and the results indicate that the longitudinal resonances have characteristics very similar to those of the plane wave resonances. Author

N70-24770*# Geotronics, Inc., Falls Church, Va.
FOUR ARM CONICAL SPIRAL ANTENNA Final Report
[1970] 77 p refs
(Contract NAS5-11165)
(NASA-CR-109493) Avail: CFSTI CSCL 09E

A four arm conical spiral antenna was developed to operate with the IRLS system to provide optimum patterns for balloon packages when interrogated from a satellite. The antenna has a bifolium shaped pattern which minimizes the energy radiated at negative elevation angles. The antenna is circularly polarized with a relatively low axial ratio near the horizon. These two characteristics combine to give an antenna with good multipath discrimination which is important for the IRLS system. The work performed during the antenna development is described. The results obtained are close to or exceed the design goal in all respects. The characteristics of the final production models are described. Author

N70-24790 Virginia Polytechnic Inst., Blacksburg.
A NUMERICAL-ITERATIVE SOLUTION OF THREE DIMENSIONAL DIPOLE ARRAYS
Ronald Carl McConnell (Ph.D. Thesis) 1969 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-19978

K. K. Mei's direct numerical integration method is extended by an iterative process and applied to the solution of the simultaneous integral equations of coupled dipoles. The procedure is specifically adapted for use on a digital computer. Isolated dipole currents are used as zero-th order approximations with which to begin the iterative procedures. Solutions are obtained for the currents, impedances, and radiation patterns of three-dimensional arrays of parallel, thin cylindrical dipoles. Dipoles are center-fed by slice generators. Dipole centers may be arbitrarily located in XYZ space. Lengths and length-to-diameter ratios may vary for each element. Provisions are made for specifying relationships between feed-point voltages, feed-point currents, current maximums, or combinations of these. Results agree favorably with those obtained by standard techniques for cases for which data are available. Dissert. Abstr.

N70-24791 Kansas Univ., Kansas City.
FREQUENCY AND TIME DOMAIN ANALYSIS OF SUPERCONDUCTIVE COAXIAL LINES
William Donald McCaa, Jr. (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-21550

Methods and data for calculating the time and frequency responses of miniature superconductive coaxial transmission lines using the phenomenological Gorter–Casimir two fluid model and the complete BCS theory were developed and applied to miniature 50 ohm lead-teflon-niobium lines. The calculated line attenuation and 1 thru 100 pico-second step responses of an 80 foot coaxial line are presented. These responses are presented over a temperature range of 2.3 K thru 10 K when using the two fluid model, considering the anomalous and classical cases (with and without relaxation effects) for the normal conductor, and for a temperature of 4.24 K when using the BCS theory in its complete form. Dissert. Abstr.

N70-24873 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A WORLD-WIDE LUNAR RADAR TIME SYNCHRONIZATION SYSTEM
W. S. Baumgartner and M. F. Easterling *In* AGARD Advanced Navigational Tech. Jan. 1970 p 143–162 refs (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A system is described which is capable of synchronizing clocks at remote locations with a master clock to within a few microseconds by means of radar reflections from the moon for the Deep Space Network. The needs of the Deep Space Network for time synchronization are described, several possible methods of synchronizing are compared, and the factors favoring the radar

method are given. The method by which a range gated radar may be used to obtain precise time synchronization via a diffuse target is described and a theory for calculating the performance of such a radar is developed. An analysis using this theory shows that a radar with quite modest capability will produce a detectable return signal. Because it was desired to synchronize many remote clocks to one master clock, the design was constrained to make the radar receiver, which is located with the remote clock, as simple as possible. It proved feasible to use a fixed tuned receiver with a four-foot antenna and inherently unattended operation. Test results and operating experience are presented and analyzed. Author

N70-24874 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A METHOD FOR PRECISION MEASUREMENT OF SYNCHRONIZATION ERRORS IN TRACKING-STATION CLOCKS
W. Martin, F. Borncamp, and E. Brummer (NASA, Langley Res. Center) *In* AGARD Advanced Navigational Tech. Jan. 1970 p 163–184 refs (See N70-24851 11-21)
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It was realized that the selenodetic objectives of the lunar orbiter mission could not be achieved unless the clock synchronization error between the tracking stations could be measured with an accuracy of 50 microseconds or better. A time synchronization error measurement technique which uses the Deep Space Network's Mark 1 ranging system to provide an improvement in accuracy of approximately 1000 times over previous methods was devised and is described. The system's theory, design, operation, economy, and versatility are discussed. Test results are included from three ground stations showing the time error of closure to be of the order of one-tenth microsecond. Author

N70-24914# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PREDICTIONS OF TRANSHORIZON FIELD STRENGTHS USING MODELING TECHNIQUES
Robert K. Crane 17 Oct. 1969 34 p refs
(Contract AF 19(628)-5167)
(AD-698335; TN-1969-53; ESD-TR-69-320) Avail: CFSTI CSCL 17/2

Four propagation mechanisms are known which can cause detectable signal levels beyond the horizon. To investigate the potential of these mechanisms for causing interference, typical and extreme values were computed for models of the different propagation mechanisms, terrain diffraction, turbulent scattering, precipitation scattering, and ducting. The propagation path used for the model computations was 175 km long passing over irregular low lying terrain. The terminals of the path were taken to model a possible satellite earth station, radio relay station configuration. The radio relay station was assumed to have an antenna with a 2.5 deg half-power beamwidth. The earth station antenna was assumed to have a 0.5 deg half-power beamwidth. A wavelength of 5 cm was used for the computations. Author (TAB)

N70-24928# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VOICE-OPERATED GAIN-ADJUSTING AUTOMATIC VOLUME-LIMITING AMPLIFIER
Chi Hsiang-Chung 22 Aug. 1969 16 p refs Transl. into ENGLISH from Tien Tzu Chi Shu Mainland (China), no. 11, 1966 p 21–24
(AD-699120; FTD-HT-23-1471-68) Avail: CFSTI CSCL 17/2

An introductory discussion is given of the voice-operated gain-adjusting device (vogad) used to maintain a constant speech output level in long-distance radio telephony. The operating principle of the device consists of three circuit sections: (1) communication, (2) control feedback, and (3) syllabic detection feedback. TAB

N70-24937 Polytechnic Inst. of Brooklyn, N.Y.
TE AND TM PROPAGATION IN A SYMMETRIC PORTION OF THE EPSTEIN PROFILE WITH APPLICATION TO OPTICAL RESONATORS
Jerome Swartz (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-20376

The exact solution to the transverse electric (TE) and transverse magnetic (TM) boundary value problems are determined for the inhomogeneous wave equations for an infinite medium whose transverse permittivity variation is a symmetric portion of the Epstein profile. The TE and TM eigenfunctions and eigenvalues are seen to be practically equal and are further shown to asymptotically approach the Weber functions (parabolic profile TE results) in the quasi-homogeneous limit of relatively large x sub o. These results are applied to an investigation of the TE and TM modes of an optical resonator cavity filled with a secant-squared medium. Adopting a modal expansion approach, the laser integral equation is established for the resonant modes for infinite-strip plane parallel reflector geometry and results are obtained in the cases of strong and weak inhomogeneity. Dissert. Abstr.

N70-24967# Queens Univ., Kingston (Ontario). Dept of Electrical Engineering.
THE RESOLUTION CAPABILITY OF RADAR SIGNALS WITH RANDOM PARAMETERS
L. J. Reay Jan. 1970 95 p refs
(Contract DSS-OPJ9-6)
(RR-70-1) Avail: CFSTI

The advantage of being able to vary radar signal parameters in a hostile jamming environment has motivated a study of how such a variation affects the resolution capability of the radar. A random model for the variation is assumed. The shape of the resultant ambiguity surface is investigated when signal parameters such as pulse-width, frequency, and pulse-repetition-time are randomly varied. New theoretical results for the average ambiguity surface and a measure of spread about this surface are given. Computer generated plots showing sections of the ambiguity surface are presented for a number of cases and asymptotic results are given for certain regions along the doppler axis. Author

N70-24972# France. Ministere de L'Air, Paris.
DEVELOPMENT OF A HIGH POWER, HIGH FREQUENCY, WIDEBAND AMPLIFIER: APPLICATION TO IONOSPHERIC SOUNDING BY RETRODIFFUSION [REALISATION D'UN AMPLIFICATEUR HAUTE FREQUENCE LARGE BANDE DE GRANDE PUISSANCE: APPLICATION A UN SONDEUR IONOSPHERIQUE PAR RETRODIFFUSION]
Daniel Raoux 1969 97 p refs In FRENCH
(NT-169) Avail: CFSTI

A high power, high frequency broadband amplifier was developed for the study of the reflecting properties of ionospheric layers. Frequency variations are obtained by using an emitter composed of a high power, high frequency broadband amplifier, and by providing a frequency emission receptor. Emphasis is placed on the calculation and development of the broadband transformer, and the completion of the emitter-receptor. Experimental results indicate that this device also allows for research and examination of backscattering echoes. Transl. by J.M.C.

N70-24998 Pennsylvania Univ., Philadelphia.
THE SCATTERING OF PARTIALLY POLARIZED WAVES BY ROUGH SURFACES
Lee Bracken Spence (Ph.D. Thesis) 1969 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-21432

Intially, it is shown that the transformation constitutes a

general characterization of the scattering process. The J's are the coherency matrices of the incident and scattered waves, and P is a matrix describing the scattering properties of the surface. By investigating the mathematical properties of the formal transformation, it is possible to derive general theorems about the scattering process. In particular, the existence of polarizations of the incident wavefront which do not change on scattering is demonstrated. The existence of an incident wavefront polarization from which no power is scattered into a particular receiving antenna is confirmed. A theorem is developed in which a procedure for maximizing the power scattered into a particular direction is given. Dissert. Abstr.

N70-25000# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Science and Technology Div.
RF TRANSMITTER TYPE TM-21, TECHNICAL MANUAL
Paul A. Stone 31 Mar. 1969 34 p
(EGG-1183-493; B-3981) Avail: CFSTI

A general description of the transmitter for airborne timing and firing capabilities, and instructions for its installation, operation, and maintenance are presented. N.E.N.

N70-25033# Scientific Group for Space Research, Athens (Greece).
DATA OF SOLAR-TERRESTRIAL INTEREST, APRIL 1969
D. J. Ilias and D. P. Elias Apr. 1969 22 p
Avail: CFSTI

Observations of the ionospheric stations and optical tracking stations are presented with graphs for diurnal variations of signal levels. Solar flare effects on short wave fadeout, and ionospheric propagation are tabulated. Optical observations of satellites are also included. F.O.S.

N70-25034# Joint Publications Research Service, Washington, D.C.
TRACKING SYSTEMS WITH OPTICAL COUPLINGS
M. V. Yefimov 20 Mar. 1970 18 p refs Transl. into ENGLISH from the book "Sledyashchiye Sistemy s Opticheskimi Svyazyami" Moscow, Energiya Press, No. 358, 1969 p 3-16
(JPRS-50109) Avail: CFSTI

The multidimensional Fourier transformation is used to determine the static characteristics for the elements of optically coupled tracking systems, and the deterministic random electrical signals at the output of photoelectric devices. These following problems are investigated: standard schemes, theory of transformation, stability, statistical characteristics, and statistical dynamics. F.O.S.

N70-25048# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Science and Technology Div.
SATELLITE COMMUNICATIONS STUDY: PRELIMINARY REPORT
C. Sundstrom and W. Brown 3 Jul. 1969 85 p refs
(EGG-1183-512; TR-B-4048) Avail: CFSTI

LASL has established the need for a satellite communications system to provide a reliable, long-range timing relay and voice communications link between ground stations and diagnostic aircraft, and between aircraft dispersed over vast areas. A study into the potentials of a satellite link to provide the required communications is presented. The concept of satellite communications, tests, future status and considerations, and conclusions pertinent to this program are outlined. Author (NSA)

N70-25073 Polytechnic Inst. of Brooklyn, N.Y.
SPACE-TIME DIRECTIVITY OF FINITE ANTENNAS
Leon Susman (Ph.D. Thesis) 1969 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-20375

The limitations and constraints that free space imposes on the polychromatic space-time packet that an antenna of finite size can efficiently radiate are discussed. It is well known from steady state consideration that there is no theoretical limit to the maximum directive gain that can be obtained from an antenna of finite size. If one limits the complexity of the radiating structure by placing an upper bound, N, on the highest order spherical mode for which excitation is permitted, then the maximum directive gain is limited. It is shown that the pattern functions corresponding to these maximal directivity excitations have a single main peak and approach an impulse as the number of modes allowed increases without bound. Under the same constraint, it is found that pattern functions, more concentrated in the direction of the main beam, can be obtained by choosing the excitation coefficient of the spherical wave expansion to minimize the beam spread. Dissert. Abstr.

N70-25126# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
THE RADIATION PATTERN AND IMPEDANCE OF A MONOPOLE ON A CIRCULAR GROUND PLANE
J. L. Whitrow Sep. 1969 39 p refs
(WRE-TN-ED-175) Avail: CFSTI

The radiation pattern of a monopole on a circular ground plane may be calculated as the sum of a geometrical optics field, and a field due to diffraction by the edge of the ground plane. The geometrical theory of diffraction is used to find the diffracted field. The impedance of the monopole is calculated by adding a correction term due to edge diffraction to the impedance of the monopole in an infinite ground plane. The theoretical radiation patterns for quarter wave monopoles on discs with radii of one, two, three, and four wavelengths are compared with measurements, and the impedance compared with previously published theoretical and measured results. In both the patterns and impedance calculations, the agreement with measurements is good. Author

N70-25134 Pennsylvania Univ., Philadelphia.
EFFICIENT COMMUNICATIONS OVER ASYMMETRIC CHANNELS
Neil Francis McAllister (Ph.D. Thesis) 1969 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-21397

Asynchronous multiplexing is discussed. The extent to which coding techniques can be employed to combat the mutual interference that results when a number of users share a common binary channel, is investigated. Each user employs a pulsed signal, rather than a constant envelope signal. In the absence of thermal noise, the corresponding channel model, for this asynchronous multiplexing technique, is a totally asymmetric (or Z) channel. The coding problem that these channels present in detail is treated. It is possible to model a satellite communication system as a Z channel in cascade with a binary symmetric channel. The Z channel accounts for the mutual interference that exists on the uplink and the binary symmetric channel accounts for the effects of an independent, additive downlink noise. The performance of this system is insensitive to power imbalances among the uplink signals. Dissert. Abstr.

N70-25136 Pennsylvania Univ., Philadelphia.
ELECTROMAGNETIC DIFFRACTION BY A MOVING HALF-PLANE
Richard Drury Jones (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-21376

The problem of electromagnetic plane wave diffraction by the straight edge of a uniformly moving, perfectly conducting

half-plane is investigated and solved relativistically. Starting with a contour integral representation of the electric field in the proper frame of the half-plane, a new integral expression is obtained in the proper frame of a laboratory observer by means of the Lorentz transformation and the phase invariance principle. A modified saddle point method is used to evaluate the integral expression asymptotically in the laboratory frame. The resulting solution is valid at almost all points in the far field, including those in the neighborhood of the apparent geometric shadow boundaries. Results are presented for the case of an incident plane wave polarized parallel to the edge of the half-plane. Due to the relative motion between the half-plane and the observer, the observed instantaneous angular diffraction pattern is both shifted (geometric shadow boundary shift) and compressed. Dissert. Abstr.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-23991# Illinois Univ., Urbana. Dept. of Physics.
ULTRA-LINEAR 16-BIT DIGITAL-TO-ANALOG CONVERTER
Dennis R. Zander 20 Nov. 1969 18 p refs
(COO-1195-174) Avail: CFSTI

The error analysis and the design of a 16-bit binary digital-to-analog converter are discussed. This method of conversion switches binary-weighted constant current sources into a summing junction, in this case the yoke of a CRT. A conversion linearity of 0.00025% and a stability of 0.0004%/hour were measured for a full scale current of one ampere showing that a converter linear to better than 16-bits can be constructed requiring no trimming of components. Author (NSA)

N70-24037# Michigan Univ., Ann Arbor.
A NETWORK-VARIATIONAL BASIS FOR GENERALIZED COMPUTER REPRESENTATION OF MULTIFREEDOM, CONSTRAINED, MECHANICAL SYSTEMS
Milton A. Chace May 1969 49 p refs
(Contract DA-49-083-OSA-3050; ARPS Order 716)
(AD-698490; TR-18) Avail: CFSTI CSCL 20/11

A vital component of computer-aided engineering design is the base program which computes the behavior of an arbitrary design, given a minimal input of both the structural identity and the design parameters. The paper considers the computer-aided design of multifreedom, constrained mechanical systems (realistic machinery). Characteristics of such systems and their computational representation and graphic display output are discussed in terms of an example machine system. An outline of mathematical methods useful for generalized representation is made. Finally an organizational scheme for implementation of a generalized program is briefly discussed. A preliminary program based on these methods is presently under test. Author (TAB)

N70-24060# Massachusetts Inst. of Tech., Cambridge.
RECOGNITION OF TOPOLOGICAL INVARIANTS BY ITERATIVE ARRAYS
Wendell Terry Beyer 24 Oct. 1969 147 p refs
(Contract Nonr-4102(01))
(AD-699502; MAC-TR-66) Avail: CFSTI CSCL 9/2

A study is made of the recognition and transformation of figures by iterative arrays of finite state automata. A figure is a finite rectangular two-dimensional array of symbols. The iterative arrays considered are also finite, rectangular, and two-dimensional. The automata comprising any given array are called cells and are assumed to be isomorphic and to operate synchronously with the state of a cell at time $t + 1$ being a function of the states of it and its four nearest neighbors at time t. At time $t = 0$ each cell is placed in one of a fixed number of initial states. The pattern of initial states thus introduced represents the figure to be processed. The resulting sequence of array states represents a computation based on the input figure. If one waits for a specially designated cell to indicate acceptance or rejection of the figure, the array is said to be working on a recognition problem. If one waits for the arrays to come to a stable configuration representing an output figure, the array is said to be working on a transformation problem. In addition to the formal results, several open questions are presented and some iterative programming techniques are considered. Author (TAB)

N70-24067# Oak Ridge National Lab., Tenn.
THE HIGH FLUX ISOTOPE REACTOR (HFIR) CONTROL COMPUTER OPERATING SYSTEM
H. P. Danforth 21 Nov. 1969 15 p refs Sponsored by AEC
(ORNL-TM-2758) Avail: CFSTI

A description of the major operating executive programs, job processing programs, program editor, and the on-line system modifier is given. The off-line functions, which are available to the system programmer, are listed and described in detail. The operating executive programs for the HFIR digital control system were modified and extended to produce an effective on-line control scheme as well as an efficient off-line program development mode. Author

N70-24085# Massachusetts Inst. of Tech., Cambridge.
PRACTICAL TRANSLATORS FOR LR(K) LANGUAGES
Franklin Lewis De Remer (Ph.D. Thesis) 24 Oct. 1969 221 p refs
(Contract NONR-4102(01))
(AD-699501; MAC-TR-65) Avail: CFSTI CSCL 9/2

A context-free syntactical translator (CFST) is a machine which defines a translation from one context-free language to another. A transduction grammar is a formal system based on a context-free grammar and it specifies a context-free syntactical translation. A simple suffix transduction grammar based on a context-free grammar which is LR(k) specifies a translation which can be defined by a deterministic push-down automation (DPDA). A method is presented for automatically constructing CFSTs (DPDAs) from those simple suffix transduction grammars which are based on the LR(k) grammars. The method is developed by first considering grammatical analysis from the string-manipulation viewpoint, then converting the resulting string-manipulation algorithms to DPDAs, and finally considering translation from the automata-theoretic viewpoint. The results are relevant to the automatic construction of compilers from formal specifications of programming languages. If the specifications are, at least in part, based on LR(k) grammars, then corresponding compilers can be constructed which are, in part, based on CFSTs. Author (TAB)

N70-24116# Texas Univ., Austin. Electronics Research Center.
PARALLEL COMPUTING STRUCTURES AND ALGORITHMS FOR LOGIC DESIGN PROBLEMS
Roy Miller Matney, II and C. H. Roth 11 Jul. 1969 124 p refs
(Grant AF-AFOSR-67-0766E)
(AD-699218; TR-68; AFOSR-69-2132TR) Avail: CFSTI CSCL 9/2

Solution of large logic design problems include manipulation, simplification, minimization and realization of logic equations, state table reduction, state assignment and realization of sequential

machines, digital system simulation, and wiring simplification. To efficiently solve logic design problems a computing structure that fits the problem structure is needed. Parallel versions of eleven algorithms in the above areas are developed to help determine a more efficient computing structure. Several types of parallel computing structures are examined, and the associative structure is found to be best suited for logic design problems. A restructurable system and a pseudo-restructurable system are proposed to overcome some of the problems which exist in present associative structures. A machine instruction set is proposed for the two systems. Advantages of associative systems are demonstrated by three machine language programs - iterative consensus, row and column dominance, and function multiplication. Programming is simplified because many of the needed operations can be done in parallel with a single instruction and because of similarities between the algorithm structures and the system structure. Parallel languages are also examined, and a parallel language for solution of logic design problems is proposed. A specialized associative computing system is shown to effectively solve many logic design problems. Author (TAB)

N70-24143# Dartmouth Coll., Hanover, N.H. Kiewit Computation Center.
AN ALGOL 68 GARBAGE COLLECTOR Technical Memorandum
Sidney Marshall 5 Dec. 1969 9 p refs
(Contract F44620-68-C-0015)
(AD-699216; TM-011; AFOSR-70-0014TR) Avail: CFSTI CSCL 9/2

The report describes the logic and use of a sub-program of ALGOL-68 identified as a Garbage Collector. The Garbage Collector handles the functions of: making or referencing, a compacting part where marked words are moved in contiguous blocks and a pointer adjustment. TAB

N70-24188# Bureau of Mines, Tiburon, Calif. Marine Minerals Technology Center.
ADAPTATION OF A SLOW-SPEED DATA ACQUISITION SYSTEM TO RECORD MULTIPLE TIME-RELATED SIGNALS
R. Newman and E. L. Corp Apr. 1970 12 p
(BM-RI-7374) Avail: Issuing Activity

An inexpensive slow-speed data acquisition system was adapted to digitally record multiple parameters simultaneously at intervals of 15 seconds. The system was built for use with standard soils testing equipment to automatically record load and displacement parameters at predetermined instants in time. Simultaneous readout is achieved by the use of special signal conditioner and sample-and-hold circuits which read the multiple signals simultaneously and hold them until the slow acting system can print out. Three channels of a 10-channel system have been converted and found to operate successfully during a series of direct shear tests. A unique feature of the system, which significantly reduced its cost, is the power supply units. Dummy circuits are used to maintain a constant power demand during sampling, thus eliminating the need for a costly power supply with rapid response characteristics. The entire system, having an overall accuracy of 0.25 percent, was put in operation for a cost under $2,500. Author

N70-24230# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
CONTROLLED INFORMATION SHARING IN A COMPUTER UTILITY
Dean Hanawalt Vanderbilt (Ph.D.Thesis) 24 Oct. 1969 173 p refs
(Contract Nonr-4102(01); Proj. MAC)
(AD-699503; MAC-TR-67) Avail: CFSTI CSCL 9/2

A computer utility is envisioned as a large, multi-access computer system providing its users with the ability to store information and share its use with other system users. This thesis considers the nature of information sharing and how a computer utility can provide facilities allowing such sharing to take place in a controlled manner. From a discussion of the goals of a computer utility, a set of requirements for the facilities of the utility is described. A model is developed which presents a method for structuring information. It is shown that the mechanisms of the model preserve certain structural characteristics of the information, and that these properties can be directly related to the requirements regarding the control of shared information. Extensions of the basic model are described which allow more selective types of control and which remove some of the limitations of the basic model. Author (TAB)

N70-24234# Illinois Univ., Urbana. Coordinated Science Lab.
ISL: A NEW PROGRAMMING LANGUAGE FOR INFORMATION RETRIEVAL
R. T. Chien, S. R. Ray, and F. A. Stahl Dec. 1969 29 p refs
(Contracts DAHB07-67-C-0199; OE-C-1-7-071213-4557)
(AD-699356; R-449) Avail: CFSTI CSCL 9/2

A software package for information retrieval purposes is presented. The core of this package is a new language called Information Search Language (ISL) which was developed to facilitate the manipulation of real character strings in an interactive environment. After a discussion of the ISL language and some of its characteristics, two application programs, REQUEST and RECALL are then described to illustrate the many attractive features of the software. Author (TAB)

N70-24245# Illinois Univ., Urbana. Coordinated Science Lab.
PHRASE DICTIONARY CONSTRUCTION METHODS FOR THE R2 INFORMATION RETRIEVAL SYSTEM
James Merritt Jansen, Jr Dec. 1969 64 p refs
(Contracts DAAB07-67-C-0199; OE-C-1-7-071213-4557)
(AD-699354; R-447) Avail: CFSTI CSCL 9/2

The R2 Information Retrieval System, when complete, will be a question-answer information retrieval system in which a person, having questions over a pre-determined data base, will be able to receive answers to his questions. The paper concerns the initial processing of the data base for the R2 system and explores initially several simple strategies for retrieving relevant statements, rather than answers, for a given question over the data base. The paper is first concerned with the construction of a phase dictionary from the data base, and, secondly, with the development of several initial attempts for information retrieval from the data base. Author (TAB)

N70-24262# Texas Univ., Austin. Electronics Research Center.
SUPERVISED LEARNING RECURSIVE FILTERS FOR OPTIMAL STRUCTURE AND PARAMETER ADAPTIVE PATTERN RECOGNITION. CASE 1: CONTINUOUS DATA Technical Report
D. G. Lainiotis 10 Sep. 1969 37 p refs
(Grant AF-AFOSR-67-0766)
(AD-699220; AFOSR-69-2758TR; TR-75) Avail: CFSTI CSCL 9/4

Recursive filters for supervised learning Bayes-optimal adaptive pattern recognition with continuous data are derived. Both off-line (or prior to actual operation) and on-line (while in operation) supervised learning is considered. The concept of structure adaptation is introduced and both structure as well as parameter adaptive optimal pattern recognition systems are obtained. Specifically, for the class of supervised learning pattern recognition problems with gaussian process models and linear dynamics, the adaptive pattern recognition systems are shown to be decomposable (partition theorem) into a linear, non-adaptive part consisting of recursive, matched Kalman filters, a nonlinear part--a set of probability

computers--that incorporates the adaptive nature of the system, and finally a linear part of the correlator-estimator (Kailath) form. Author (TAB)

N70-24283# Dartmouth Coll., Hanover, N.H.
[ALGOL 68 IMPLEMENTATIONS]
S. Marshall 1 Dec. 1969 13 p refs
(Contract F44620-68-C-0015)
(AD-699215; AFOSR-70-0014TR) Avail: CFSTI CSCL 9/2

A two pass ALGOL-68 Compiler for the G.E.-635 time-sharing system, which is as machine independent as is technically practical, and which is for both systems programming and educational support, is described. The report contains new creative information on the logic used in its development. TAB

N70-24383 Polytechnic Inst. of Brooklyn, N.Y.
ADAPTIVE EQUALIZATION WITH A SECOND-ORDER GRADIENT ALGORITHM
Carrie Devieux (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-20327

This dissertation introduces a new algorithm, called the Second-Order-Gradient algorithm (S.O.G.) which offers some definite advantages with respect to rate of convergence when compared with the First-Order-Gradient algorithm which is the one most commonly used in existing adaptive equalizers. The S.O.G. has a noise smoothing property which makes it more noise-resistant when the observations are corrupted by noise, guaranteeing faster convergence in a nonnegligible noise environment. The basic structure of the equalizer is the common tapped delay line. The distortion function to be minimized is the mean-square error between the equalized signal and a reference signal locally generated. Dissert. Abstr.

N70-24389# Columbia Univ., New York.
PROCEEDINGS FOR THE SKYTOP CONFERENCE ON COMPUTER SYSTEMS IN EXPERIMENTAL NUCLEAR PHYSICS
Oct. 1969 652 p refs Conf. held at Skytop, Pa., 3-6 Mar. 1969
(CONF-690301; EANDC(US)-121-U) Avail: CFSTI

Various information and computer systems applied to nuclear physics research are reviewed, emphasizing real time, on-line, and time sharing systems. Computers and electronic devices for data acquisition are presented, as well as programming languages. The economic aspects of these computer systems are also cited. J.A.M.

N70-24392 Polytechnic Inst. of Brooklyn, N.Y.
BURST-ERROR CORRECTION
John Dewey Bridwell (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms HC $5.60/Microfilm $3.00 Order No. 69-20319

Encoding of binary data such that errors introduced by a burst-noise channel may be corrected is discussed. Both single burst correcting (SBC) and multiple burst correcting (MBC) codes are considered. The concept of burst distance is defined and the burst-correcting properties of a code relative to its burst distance are subsequently developed. A class of SBC codes related to Gilbert codes is analyzed. A tradeoff is shown to exist between the block length and the SBC capability for a code from this class. The exact SBC ability of Gilbert codes is also derived. Product codes are shown to have MBC capabilities. The MBC properties of product codes are found from the parameters of the subcodes. A class of product codes is defined such that single, triple and quadruple bursts as well as five single errors within a block are correctible. A simple decoding algorithm is given for this class of codes, thus indicating that product codes may be well-suited to practical applications. Dissert. Abstr.

N70-24397 Pennsylvania Univ., Philadelphia.
CELLULAR-ARRAY REALIZATION OF FINITE-STATE SEQUENTIAL MACHINES
Jung-chang Huhng (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-21370

A new type of fixed-cell, fixed-interconnection homogeneous cellular array that is capable of realizing any n-input, n-output combinational switching network is developed. The array is composed of identical combinational logic cells with three inputs and three outputs. The logic cells are arranged in a rectangular array with uniform interconnection structure. The signal flow is unilateral in vertical direction and bilateral in horizontal direction. Each n-column array is capable of realizing any set of n functions of n variables. The functional capabilities of the array can be changed by appropriately setting the parameters on the edges of the array. An algorithm for the realization of any given 2(n) state sequential machine by using a single n-column array is presented. The theoretical work that leads to the synthesis of this array is also presented. Dissert. Abstr.

N70-24459*# Raytheon Co., Sudbury, Mass. Equipment Div.
APOLLO GUIDANCE COMPUTER PROGRAM BLOCK 1 (100) AND BLOCK 2 Final Report, 25 Jul. -31 Dec. 1969
31 Dec. 1969 108 p Prepared for Gen. Motors Corp.
(Contract NAS9-497)
(NASA-CR-108361; SR70-4053) Avail: CFSTI CSCL 09B

The design effort and the development and fabrication of Apollo guidance computer subsystems and associated airborne, simulation, and ground support equipment is summarized. Primary emphasis is placed on the engineering, manufacturing, and reliability and quality assurance effort provided during the program. Highlights of significant events, problems encountered, and their solutions are described. Author

N70-24477# New York Univ., N.Y. School of Engineering and Science.
LANGUAGES FOR PROGRAMMING AUTOMATIC TEST EQUIPMENT INCLUDING AN INTRODUCTION TO ANALOG AND DIGITAL COMPUTERS
Gabriel Garcia-Aguilar Jan. 1969 36 p refs
(Contract N00039-68-C-3579)
(AD-699508; SETE-210/98) Avail: CFSTI CSCL 9/2

The report deals with languages used to program electronic computers for automatic testing. The primary purpose of the report is to tabulate, and explain the various languages so far developed to meet these testing requirements. Author (TAB)

N70-24484# Mitre Corp., Bedford, Mass.
THE MI-3 ASSEMBLER REFERENCE MANUAL
Robert W. Cornelli Dec. 1969 49 p
(Contract F19628-68-C-0365)
(AD-699237; MTR-967; ESD-TR-69-371) Avail: CFSTI CSCL 9/2

MI-3 is a primitive, interactive, one pass assembler which assembles in-core code for a family of microprogrammed computers based on an Interdata 3 (I-3) micromachine. Author (TAB)

N70-24524 Pennsylvania Univ., Philadelphia.
CROSSTALK AND REFLECTIONS ON PULSED LINES
Joseph Leon Kozikowski (Ph.D. Thesis) 1969 322 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No.

69-21383

As computer speeds increase, so also do interconnection problems associated with high frequencies, e.g., delays, reflections and coupling. General approaches to the solution of cross-talk and reflections on pulsed, lossless lines are attempted. A method for computing multiple reflections in a cascade of line sections and linear four-terminal networks is presented. This method is formulated for efficient computer solution, and there are no restrictions on the number of sections or reflections, other than the practical limitation of computer time and storage. If the networks contain reactances, Fourier or Laplace Transforms may be used to compute the transient response. An alternate approach, using Gaussian functions, is discussed. This approach simplifies the time domain solution and is applicable when pulse distortion is not large. Dissert. Abstr.

N70-24593# National Bureau of Standards, Washington, D.C. Computer Technology Section.

COMPUTER/DISPLAY INTERFACE STUDY Final Report, 1 Jan. 1968 – 31 Dec. 1968

Paul Meissner, Donald E. Rippy, Jerome Hudson, Donald Shook, and Thomas N. Pyke, Jr. Apr. 1969 213 p refs

(AD-699366; ECOM-95844-F) Avail: CFSTI CSCL 9/2

The study has accomplished research and development on the interfacing of displays to computer systems in support of a number of newly emerging display devices. The study has included the investigation of graphical display languages, data structures, and interaction with the display user. The work has been based upon the use of R and D facilities at NBS including the MOBIDIC-B time shared computer system and the newly constructed MAGIC II display terminal. The report includes as appendices supplementing reports on MAGIC II-Graphical Display Terminal Interfaced to a Digital Computer, GRAS-A Graphical Assembler for MAGIC II, and A Communication Controller for a Time Shared Computer Research Facility. Author (TAB)

N70-24612 Iowa Univ., Iowa City.

MEMORY CELL USING BISTABLE RESISTIVITY IN AMORPHOUS AS-TE-GE FILM

Charles Henry Sie (Ph.D. Thesis) 1969 83 p

Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-20670

Electrically reversible bistable resistivity was established in As.55Te.35Ge.10 glass. The switchability of evaporated glass film between two orthogonal arrays of conductors was ascertained. Typical measured voltage and current threshold values were 4 volts and 8 mA. The high to low resistance ratio was 10,000 or greater. Using integrated diodes for back coupling isolation, a small memory array was constructed. The worst case read and write sneak path noise was analyzed for large arrays of such cells. The analysis indicated that a memory module of 1 million bits with a read cycle time of 200 nsec is possible with a density of 0.25 million bits/sq in. The array considered is functionally an electrically alterable read only memory. Dissert. Abstr.

N70-24619# Idaho Nuclear Corp., Idaho Falls.

TIME OF FLIGHT INTERFACE

G. B. Morgan Jun. 1969 39 p

(Contract AT(10-1)-1230)

(IN-1294) Avail: CFSTI

The time-of-flight interface described in this report allows the velocity selector and high pressure experiments to be run under computer control. There are two main sections which compose the interface: (1) the program controlled portion in the ToF remote chassis; (2) the direct memory access logic located in the ToF common logic. The unit is capable of collecting data at the average rate of the DMA channel or in bursts of up to 5 events within 1 microsecond without losing any events. The dead time for this unit is < or = to 200 ns. Author (NSA)

N70-24648 Carnegie-Mellon Univ., Pittsburgh, Pa.

COMPUTER PROGRAM ORGANIZATION INDUCED BY PROBLEM EXAMPLES

Donald Spencer Williams (Ph.D. Thesis) 1969 151 p

Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-19114

Interests in the fields of induction and problem solving are combined in a program called the Aptitude Test Taker, which forms a conceptualization from worked examples of an inductive reasoning task and organizes a computer program to perform the task. The development of the Aptitude Test Taker was influenced both by computer models of human performance and artificial intelligence research. The evolution of the Aptitude Test Taker was guided by detailed human performance data. The Aptitude Test Taker is a knowledgeable conceptualizer using feature extraction to induct a performance strategy. The Aptitude Test Taker uses a parsimonious set of examples rather than requiring examples of every situation that will be encountered. The performance of the Aptitude Test Taker, on tasks within its capability, parallels human performance and exceeds the performance of the other computer programs that can deal with one or more of the tasks. Dissert. Abstr.

N70-24697# Sandia Corp., Livermore, Calif.

MESHGEN: A COMPUTER CODE FOR AUTOMATIC FINITE ELEMENT MESH GENERATION

J. L. Egeberg Jul. 1969 42 p

(Contract AT(29-1)-789)

(SCL-DR-69-49) Avail: CFSTI

MESHGEN automatically generates and plots finite element mesh data for use with finite element computer programs, and is especially oriented toward axisymmetric codes such as program ARBAS. Boundary conditions may also be prescribed prior to the mesh generation. An option is included for punched output data for use as input for the finite element codes. MESHGEN and ARBAS will also be available in coupled form to give a single-mesh-generating finite element code. Author (NSA)

N70-24718# Naval Postgraduate School, Monterey, Calif.

BUILT-IN SELF-TEST FOR AN AIRBORNE DIGITAL COMPUTER

Edward Oliver Bierman (M.S. Thesis) Jun. 1969 117 p refs

(AD-698496) Avail: CFSTI CSCL 9/2

The report describes the design of a built-in self-test capability for a military airborne digital computer. The supportive investigation of program constraints and their effects on the example test design is intended to give broad perspective to the general self-test design problem. Alternate procedures for achieving the goal of airborne detection and isolation of a certain class of failures to the modular level are surveyed. A specific test design is evolved illustrating the unique mix of program-oriented, periodic techniques, and added hardware, continuous techniques best suited to the example development program. Author (TAB)

N70-24749# RAND Corp., Santa Monica, Calif.

THE GRAIL LANGUAGE AND OPERATIONS Final Report

T. O. Ellis, J. F. Heafner, and W. L. Sibley Sep. 1969 32 p refs

(Contract DAAC15-67-C-0141; ARPA Order-189-1)

(AD-698729; RM-6001-ARPA) Avail: CFSTI CSCL 9/2

The important organizational concepts of the flowchart language are the sequential flow of control, the hierarchy of subroutines, and the language (flow diagrams) that pictorially relates their interdependence. A fundamental facility of the man-machine interface is the automatic recognition of appropriate symbols, which allows the man to print or draw appropriate symbols freehand. GRAILs text-editing features include placement, replacement, and deletion of characters, character-string insertion of deletion, and

line deletion. Control functions include displaying text page-by-page, requesting specified display frames, moving symbols, and text line editing. The flowchart processes may be compiled and executed at CPU speeds or the man may control interpretative execution by direct stylus actions. He may use overlay displays or split screen displays to debug. This is the second part of a final report on GRAIL. Author (TAB)

N70-24750# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW, VOLUME 3, NUMBER 10, 1969
Wade B. Holland, ed. Oct. 1969 133 p refs
(Contract F44620-67-C-0045)
(AD-698728; RM-6000/10-PR) Avail: CFSTI CSCL 9/2

The October 1969 issue introduces preview synopses of new Soviet books of special interest to Western readers, and adds coverage of the new CPSU Central Committee newspaper. An overview of Soviet information retrieval work in science and technology is given in several articles and book excerpts, which decry the lack of adequate hardware, software, and personnel and the intolerable slowness of the publication process. System analysts, system programmers, and applied mathematicians trained in specialized higher educational institutions are particularly needed. Sciometry, a new book on the science of science, lists the problems encountered by Soviet researchers, including lack of informal participation in international exchanges, delays in receiving foreign journals, the need for a centralized reference source and computerized information services, publication delays, and the two-way language barrier. Translated articles cover the nomination for a State Prize of the manufacturer and designer of the BESM-6; the SNCC; a logic device based on neuronlike structures; a PERT method for troop control; automatic indexing work; and a new document retrieval language. Author (TAB)

N70-24753 Pennsylvania Univ., Philadelphia.
SOME APPLICATIONS OF PUSH-DOWN AND QUEUE TYPE LIST MEMORIES IN DIGITAL COMPUTER DESIGN
Willis Kwong-Tsu King (Ph.D. Thesis) 1969 206 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-21379

The practical applications of push-down and queue type devices in digital computer design are investigated. It examines the use of push-down and first-in-first-out lists as memory elements in a conventional computer system as well as their influence on the computer system design itself. The study has led to the design of a word-addressable memory using push-down or first-in-first-out lists. The study developed an all push-down machine in which every memory cell and register is a push-down list. The concept of this machine is generalized and extended and a novel computer system, the Hardware Expandable Parallel-Processing Computer System—HEPACS, is developed. It provides the user with a flexible structure which can be tailored to suit his applications; it uses a basic machine language that can be developed by the user himself; and it can perform some parallel processing without imposing any extra burden on the programmer. Dissert. Abstr.

N70-24762# California Univ., Livermore. Lawrence Radiation Lab.
SODT: A SCOPE OCTAL DEBUGGING TAPE FOR FAMILY-8 COMPUTERS
R. I. Bystroff and Roger E. Anderson 6 Nov. 1969 18 p refs Presented at DECUS Fall Symp., Las Vegas, Nev., 17–18 Nov. 1969 Sponsored by AEC
(UCRL-71959; CONF-691110-1) Avail: CFSTI

Display techniques are accepted as a powerful tool for interactive work. To date, debugging tapes for the PDP-8 family of computers have not included this feature. SODT provides this capability and frees the operator from distracting and slow typeouts of register contents. A simultaneous presentation of all pertinent registers allows the operator to react more quickly. Interpretive execution of the operator's program within the debug package is a new feature for small computer debugging programs. It enables the debugging program to set breakpoints automatically at the address specified. It also allows the debug program to follow branching instructions independent of the branch choice. With this feature, the flow and execution of the operator's program can be observed at teletypewriter speeds, or under fingertip control. Author (NSA)

N70-24821# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
NSP KERNEL-DIFFUSION LIBRARY, KDLIBE, NS0910 (USER'S MANUAL)
W. B. Henderson and W. E. Edwards [1969] 422 p refs
(GESP-226) Avail: CFSTI

The essential features necessary to use the NSP Kernel-Diffusion codes are described. All codes are written in FORTRAN IV for the GE-635 computer and are contained on a single library tape prepared by the system editor. In addition to the capability of running each of the nine codes as an independent job or activity, a kernel-diffusion sequence composed of as many as six of the codes can be run as a sequence of activities, with certain data prepared by one code passed to succeeding codes via tape or disc. Optional card output can be used as part of the card input at a later time to begin the kernel-diffusion sequence at any activity. Since all data cards and control cards necessary to run any code on the library are decimal cards, the codes can be run remotely using the GERTS system with a teletype as the remote terminal. Author (NSA)

N70-24835# Laboratorium voor Ruimteonderzoek, Utrecht (Netherlands).
ON-BOARD DATA PROCESSING
A. C. Brinkman *In* Univ. Coll., London Prelim. Design of a Cosmic X-Ray Survey Expt. Oct. 1969 refs p 72–75 (See N70-24826 11-30)
Avail: CFSTI

The use of spacecraft electronic equipment for analog and digital data processing are outlined and the functions of analog to digital converters are described. ESRO

N70-24836# University Coll., London (England). Mullard Space Science Lab.
THE ANALYSIS OF SATELLITE DATA
W. J. Raitt *In its* Prelim. Design of a Cosmic X-Ray Survey Expt. Oct. 1969 p 76–82 (See N70-24826 11-30)
Avail: CFSTI

The production of satellite data in a computer compatible form and the production of experimenters' tapes, and the tape format are discussed in this survey. The form of the output, computer programs and the influence of data analysis on the design of a satellite experiment are also considered. ESRO

N70-24900*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FEDGE: A GENERAL-PURPOSE COMPUTER PROGRAM FOR FINITE ELEMENT DATA GENERATION, VOLUME 2: PROGRAM MANUAL
F. A. Akyuz 15 Sep. 1969 81 p
(Contract NAS7-100)
(NASA-CR-109467; JPL-TM-33-431-Vol-2) Avail: CFSTI CSCL 09B

Detailed information concerning the structure of the program, the flow charts, the functions of the program, and the listings are

presented. Although this information is completely descriptive for documentation purposes, a brief summary of the composition of the arrays, dimensions, and equivalence statements and tapes used is given. The function of each link is summarized with additional information on the contents of the tape units and the meanings of prominent symbols used in the program are defined. For each link, a table is presented containing the list of programs and their functions with their decimal word length, a figure for the summarized flow chart of the link, and the complete listing of the FORTRAN and FAP programs. Author

N70-24901*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FEDGE: A GENERAL-PURPOSE COMPUTER PROGRAM FOR FINITE ELEMENT DATA GENERATION. VOLUME 1: USER'S MANUAL
F. A. Akyuz 15 Sep. 1969 41 p refs
(Contract NAS7-100)
(NASA-CR-109530; JPL-TM-33-431-Vol-1) Avail: CFSTI CSCL 09B

The program is described and the topological definitions and classifications related to the preparation of input are summarized. The logical steps for the analysis of a given geometrical configuration are explained, with emphasis on their relations with the input preparation of the actual computer program FEDGE. The program generates input data for continuous structures, which are defined by the properties associated with the closed domains and the boundary of the domains in two- and three-dimensional space. Any practical number of subdomains with different field properties can be handled by the program. The output of the program is a list of coordinates, boundary conditions, and element properties. This information is stored on the tape. With a little additional information and minor programming effort, the output can be obtained ready to use for any specific structural analysis, heat-transfer analysis, or fluid-mechanics problem. The coordinates generated can be used in finite-difference analysis. The maximum number of nodal points and elements is 8000. The execution time depends upon the complexity of the geometrical configuration and its topological forms, and requires approximately 2-4 min per subdomain. The program is written in FORTRAN II language. Author

N70-24912# New York Univ., N.Y. AEC Computing and Applied Mathematics Center.
AN INTERFACE BETWEEN A CONTROL DATA 6000 SERIES COMPUTER AND A HONEYWELL 16-BIT SERIES COMPUTER
Ronald P. Bianchini Oct. 1969 44 p
(Contract AT(30-1)-1480)
(NYO-1480-119) Avail: CFSTI

The basic design of an interface between an I/O channel of Control Data 6000 series computers and the Honeywell 16-bit series computers is described. The design incorporated an interaction of software and hardware techniques. The I/O structure and instruction list of each computer and logic diagrams of the basic and implemented designs are briefly discussed. The interface is employed in the development of graphic capabilities for both systems and as a tool for user-computer networks. Author

N70-24922 Pennsylvania Univ., Philadelphia.
A STUDY OF A CLASS OF NON-CYCLIC CODES: BICYCLIC CODES
Mark Paul Ballan (Ph.D. Thesis) 1969 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-21318

The objective of this investigation is to study a new class of systematic group codes. This class is invariant under what shall be called the bicyclic permutation (or shift). A bicyclic shift of a code word a = (a sub I,a sub P), where a sub I and a sub P are the information and parity sequences of a, is a new word with information and parity sequences which are cyclic shifts of a sub I and a sub P, respectively. This particular permutation is useful in defining a class of codes because: (1) some of the mathematics and circuitry used in implementing cyclic codes can be adapted for use in bicyclic codes; (2) the information and parity error sequences can be treated separately for the purpose of decoding (3) interesting subclasses of bicyclic codes exist; and (4) the overlap with cyclic codes is trivial. Dissert. Abstr.

N70-24943 Kansas State Univ., Manhattan.
CHARACTERIZATION OF DIGITAL SYSTEMS
Paul Eugene Gray (Ph.D. Thesis) 1969 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-21125

The essential feature of digital systems engineering is that of the simultaneous interaction of flow of intelligence and a syntax. This interaction is described in terms of digital paths, digital junctions, and a set of generalized manipulative schemes. The significant result of this description is that a new vantage point is provided from which one can view both the discipline of digital systems engineering in general and the hardware and software aspects of digital systems in particular. Using this vantage point, one can establish the procedure of selecting an alphabet, a carefully prepared dictionary, and a group of manipulative schemes for describing a specific class of digital systems. The philosophy is used as a basis for the development of a systems level design scheme called the parse-implement technique, within the general area of digital systems. The technique is based on six fundamental considerations (two systems level and four environmental level). Dissert. Abstr.

N70-24969# Technische Hogeschool, Delft (Netherlands). Laboratorium voor Energievoorziening en Kernreactoren.
MASCARA: A MULTIVARIABLE DATA-PROCESSING CODE FOR QUASI-AND NONSTATIONARY MEASUREMENTS
T. Goemans, D. van Maren, and D. G. ten Wolde Feb. 1970 38 p refs
(WTHD-18; THD-KR-196) Avail: CFSTI

This report gives a description of the MASCARA data-processing code, intended for tests where, starting from a stationary or quasi-stationary condition, a perturbation is introduced in one or more variables. The code offers the following possibilities: (1) from the total number of channels recorded on punched paper tape a certain number can be chosen arbitrarily for actual processing; (2) an arbitrary number of channels can be smoothed over either the complete test period or only the period during which the perturbation was applied; (3) an arbitrary number of channels can be differentiated with respect to time, but only after these channels have been smoothed; (4) the time period for processing can be chosen shorter than the actual test period; (5) an arbitrary number of data points can be corrected; (6) the smoothing procedure may be applied an arbitrary number of times; and (7) the data points of all channels and their derivatives can be interpolated on a common time base with an arbitrary time interval. Author

N70-24977# Weapons Research Establishment, Adelaide (Australia).
QUARTER-SQUARE MULTIPLIERS USING SERIAL DIODE FUNCTION GENERATORS
G. C. Flecker Sep. 1969 26 p refs
(URE-TM-ED-295) Avail: CFSTI

Quarter-square multipliers using serial diode function generators (a new type of diode function generator) are discussed and a method of calculation of the latter presented. Comparison is made with the conventional parallel diode function generator illustrating the economies in precise components and the ease of matching which may be gained. Author

N70-24986 Iowa Univ., Iowa City.
FIXED CLASSIFIER PATTERN RECOGNITION USING ITERATIVELY PRODUCED PREPROCESSING
Harold William Workman (Ph.D. Thesis) 1969 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-20687

A pattern recognizer whereby the classifier learns first, and is then fixed, followed by learning by the feature extractor, which must learn how to predistort the input to the fixed classifier for proper recongition of the learning set is described. The initial conditions are an initial predistortion function, whose input vector is O, and is composed of p binary valued elements. The output vector is N, and is composed of q binary valued elements. The input to the fixed classifier is N. Any classifier may be used which can correctly classify at least one N vector from each class. As a general predistortion, a unity transformation is used, with N = O, and therefore q = p. By use of the learning set of sample vectors the initial predistortion function is altered so that the pattern recognizer can correctly identify the learning set and so that performance is not degraded in the test set but is usually improved over the situation with the initial predistortion. Dissert. Abstr.

N70-25052# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE OF THE METHODS OF ORGANIZING THE INFORMATION STORAGE UNIT OF A SYSTEM OF DATA RETRIEVAL AND PROCESSING (SPOD)
R. B. Askinazi et al 30 Sep. 1969 18 p refs Transl. into ENGLISH from Nauchn.-Tekhn. Inform., Ser. 2, Inform. Protessy i Sistemy (USSR), no. 12, 1967 p 37-39
(AD-699259; FTD-MT-24-196-69) Avail: CFSTI CSCL 5/2

The paper deals with one method of organizing the storage unit of a descriptor IPS (information retrieval system) of the SPOD type, the information array of which constitutes the totality of uniform documents with ordered disposition of data within each of them. Three categories of data composing the retrieval form of a document were defined classificational, base and key. For the organization of retrieval in a group of documents with a common series of similar data, use is recommended of the process which can be automated by including a free, ordered table in the automatic dictionary of translation from the natural language to the IPYa (information retrieval language). Organization of the information storage unit anticipates the inclusion in each of its subcriteria. The SPOD ensures output of data which corresponds to the level shown in the request, as well as data below this level, but pertaining to a higher section of the document. Author (TAB)

N70-25054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERAL DESIGN OF AN ANALOG-DIGITAL COMPUTER SYSTEM BASED ON THE URAL-2 DIGITAL COMPUTER
V. M. Kirpichnikov et al 13 Aug. 1969 21 p refs Transl. into ENGLISH from Tr. Ural'sk. Politekhn. Inst. (Sverdlovsk), no. 151, 1967 p 71-83
(AD-699246; FTD-HT-23-26-69) Avail: CFSTI CSCL 9/2

An interface unit for a hybrid computer system which may use any analog machine and the Ural-2 digital computer is described. The unit makes it possible to compute with higher accuracy than is attainable with an analog machine alone, and to increase operating speed and alleviate the burden placed on the digital computers main memory in handling complex problems. The interface unit consists of A/D and D/A converters. Ten inputs and outputs are available for digitally coded information (i.e., two 10-bit flip-flop registers) and eight channels each are provided for analog input and output signals. TAB

N70-25077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR LOGIC INFORMATION PROCESSING
L. S. Levinskii et al 3 Oct. 1969 31 p refs Transl. into ENGLISH from Tr. Vses. Konf. po Inform.-Poiskovym Sistemam i Automatiz. Obrabotke Nauchn.-Tekh. Inform. 3d (Moscow), 1967 p 39-53
(AD-699227; FTD-MT-24-198-69) Avail: CFSTI CSCL 9/2

A device for improving the processing of information and thus increasing the speed of operation of digital computers is described. It does this by fulfilling two essential components of the information-logic problem: by choosing some known part of the total information block for parallel review of the entire block, and by parallel logic processing of a sequence of codes. Ordinary computers with no special device for solving these problems can solve them, but do so very slowly and require an unnecessarily complex program. By complicating the equipment to some extent, the programming system can be simplified. The basic demands made of the device are the following: associative retrieval as opposed to address retrieval; recording and counting by lines and columns; availability of any part of the information; performing logic operations in a matrix. A functional description of the device and its command system is given, and its fundamental components are explained in some detail. TAB

N70-25084# RAND Corp., Santa Monica, Calif.
THE GRAIL SYSTEM IMPLEMENTATION Final Report
T. O. Ellis, J. F. Heafner, and W. L. Sibley Sep. 1969 66 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-121)
(AD-698730; RM-6002-ARPA) Avail: CFSTI CSCL 9/2

Interactive use of the RAND Tablet/Stylus and a CRT display demands that many independent data packages be accessed in real time without the mans being aware of system operational tasks. The internal representation of the mans program consists of its picture form, data structures to denote properties implied by the picture, and positional information to relate stylus location to the other forms. Dynamic storage allocation is automatically provided because of the large number of data sets. Algorithms are described which handle scheduling, priority, synchronization, and parallel processing. This is the third part of a final report on GRAIL. Author (TAB)

N70-25087# California Univ., Berkeley.
SYSTEM OPERATION OF THE PDP-7 COMPUTERS AT LRL, BERKELEY
J. O. Radeloff, L. B. Robinson, and J. D. Meng May 1969 104 p refs
(Contract W-7405-eng-48)
(UCRL-18883) Avail: CFSTI

An on-line data-taking system based on a PDP-7 computer has been developed. The system allows a time-shared use of the computer with several counting experiments. The data areas are hardware protected against interference between different users. DEC-tapes are used for storage and retrieval of the programs. Data are stored either on DEC-tape or IBM-compatible magnetic tape. The operation of the data taking system is described. A software handling program package operating with DEC-tape is also introduced. Author (NSA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-23951# Akademiya Nauk URSR, Kiev.
ANALYSIS OF ELECTROMEASURING AND MAGNETOMEASURING DEVICES [ISSLEDOVANIYE

ELEKTROIZMERITELNYKH I MAGNETOIZMERITELNYKH USTROYSTV]
1967 184 p refs In RUSSIAN
Avail: CFSTI

Papers are presented on theoretical and experimental analyses of electrical and magnetic measuring instruments. Techniques for increasing measurement accuracy, balancing bridge circuits, and also phase measuring instruments in industrial and higher frequency ranges are discussed. For individual titles see N70-23952 to N70-23976.

N70-23954# Akademiya Nauk URSR, Kiev.
CALCULATIONS ON ac VOLTMETERS TAKING HARMONIC COMPONENTS EFFECTS INTO ACCOUNT
V. S. Skryabinskiy *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 20–25 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

The effect of harmonics in a nonsinusoidal signal on voltmeter accuracy are discussed for the case where no harmonic compensation is included in the meter circuitry. Formulas are derived for determining the error contribution of any harmonic for a given value of inductance in the meter movement. For practical purposes, only harmonics up to the 5th are considered. A similar analysis can be applied to harmonic-compensated meters. Transl. by B.E.S.

N70-23955# Akademiya Nauk URSR, Kiev.
MEASURING PHASE SHIFT IN CIRCUITS WITH NON-SINUSOIDAL CURRENT AND VOLTAGE
Yu. A. Skripnik and V. A. Khomyak *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 26–33 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Methods are proposed for measuring phase shift in circuits containing non-sinusoidal signals by defining the power factor of each harmonic present. Differential circuits for obtaining these values are suggested. The emphasis is on cases where filtering out higher harmonics is impossible, as in power and power phase angle measurements. Transl. by B.E.S.

N70-23956# Akademiya Nauk URSR, Kiev.
ERRORS IN A DIFFERENTIAL METHOD OF CHECKING THREE-PHASE PHASEMETERS
V. A. Khomyak *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 34–41 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Errors in a differential wattmeter method for checking the accuracy of a three-phase phasemeter are analyzed. The discussion applies to dual-element phasemeters where asymetry between elements is assumed to exist. Circuits for minmizing the error are proposed. A calibrating device was developed, based on the proposed circuitry, for measuring phase shift and power factor. Transl. by B.E.S.

N70-23957# Akademiya Nauk URSR, Kiev.
MEASURING NONUNIFORM FREQUENCY CHARACTERISTICS OF COMPLEX IMPEDANCES
A. D. Nizhenskiy and Yu. A. Skripnik *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 42–49 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

An improved method is proposed for measuring frequency characteristics of complex impedances, where nonuniform frequency response is assumed to exist. A circuit is given for achieving this with any four-pole by periodically comparing voltage drop across the four-pole and the drop across a reference non-reactive resistance. The comparator method reveals small changes in frequency characteristics over a wide range of original frequencies. Transl. by B.E.S.

N70-23958# Akademiya Nauk URSR, Kiev.
WIDEBAND DUAL-CHANNEL ELECTRONIC COMMUTATOR FOR PHASE MEASURING CIRCUITS
V. Ya. Dremlyuga *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 50–54 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

A transistorized dual-channel commutator is described which is designed for applying dual signals to a single-channel phasemeter. The commutator features high decoupling of the two measured signals to avoid crosstalk. Input signal range is 0.5 mV to 1V. The circuit also operates as a synchronous detector with a frequency range of fractions of a Hz to over 100 kHz. Transl. by B.E.S.

N70-23959# Akademiya Nauk URSR, Kiev.
A PHASEMETER RESONANCE INDICATOR
M. S. Yevdokimov and V. I. Skripnik (Kiev Polytech.) *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 55–61 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

A transistorized, commutated phasemeter is described which gives a precise indication of phase crossover in resonant circuits. The circuit converts the measured-signals to a modulated pulse train, yielding a phase shift accuracy of 0.25 to 0.5 degrees, over a range of 1 kHz to 1 MHz. Accuracy could be further increased by adding a wideband amplifier-limiter stage. Transl. by B.E.S.

N70-23960# Kiev Polytechnic (USSR).
A HIGH FREQUENCY PHASE NULL INDICATOR BASED ON A HALL SENSOR
V. I. Skripnik *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 62–67 In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

A circuit for precisely indicating cophasing of two signals was developed, using a Hall element as null sensor. The circuit is a refinement of an existing design which uses dc amplification of the Hall voltage; the input signals are commutated at 50 Hz, permitting ac amplification and thus eliminating zero drift error in the amplifier. Decade frequency switching is supplied to cover the 1 to 10, 10 to 100, and 100 to 1000 kHz ranges. Transl. by B.E.S.

N70-23961# Akademiya Nauk URSR, Kiev.
STABLE ac SOURCE FOR SUPPLYING A HALL SENSOR
V. V. Brayko *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 68–73 In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Two schematics are given for stable power supplies for Hall sensors: one is for low-resistance elements such as n-InSb and n-InAs; the other for high resistance types such as n-Ge and n-Si. Both circuits use a 20 kHz quartz reference oscillator and a dipped supply current waveform for frequency and amplitude stability. The first variant supplies 0.3a at 30w; the second, 30 ma at 5w. With thermostatic control, the temperature drift of current amplitude is less than 1% per 10 deg C change in ambience. Transl. by B.E.S.

N70-23962# Kiev Technological Inst. of Light Industry (URSR).
EFFECT OF METER IMPEDANCE ON ERRORS IN PHASED AND LIMITED CONSTANT-PHASE UNBALANCED BRIDGES
K. G. Rego *In its* Analysis of Electromeasuring and

Magnetomeasuring Devices 1967 p 74–79 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

The effect of finite impedance in the diagonal of a four-leg bridge is analyzed. Both active and reactive components are treated, and their effect on sensitivity and phase shift are evaluated. Results show that lowering the resistive component may not affect phase-measuring accuracy, but does reduce bridge sensitivity. It is recommended that the resistance in the diagonal leg be at least an order of magnitude greater than that in the other legs.
Transl. by B.E.S.

N70-23963# Akademiya Nauk URSR, Kiev.
INCREASING THE ACCURACY OF A QUASI-BALANCED BRIDGE CIRCUIT
Yu. V. Bratus, V. N. Kustovskaya, and Ye. N. Motora *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 80–83 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Quasi-balanced bridge circuits are proposed for measuring and directly indicating inductance and Q. The circuit recommended gives accurate readings for linear and nonlinear inductive elements. The optimum point for grounding the bridge so as to minimize the effects of stray capacitance and inductance is determined. A dual-indicator circuit is proposed which gives simultaneous readouts of inductance and Q.
Transl. by B.E.S.

N70-23964# Akademiya Nauk URSR, Kiev.
SIMPLIFIED METHOD FOR CALCULATING METERING CIRCUITS WITH INDUCTIVE VOLTAGE DIVIDERS AT THE INPUT
V. P. Karpenko and I. S. Serikov *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 84–91 In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

A simplified method is proposed for calculating matrices of impedance while ignoring mutual and self-inductance of windings in an inductive voltage divider. Several divider variations are treated, including more complex circuits with series capacitance added. With some simplifications, the loop equations for any circuit can be expressed in matrix form, which greatly reduces computation effort in determining divider element parameters. Matrices are given for the proposed circuits.
Transl. by B.E.S.

N70-23965# Akademiya Nauk URSR, Kiev.
ANALYZING THE COMPARATIVE ACCURACY OF INDUCTIVE VOLTAGE DIVIDER CIRCUITS
Yu. V. Bratus and V. P. Karpenko *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 92–97 In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Several types of inductive voltage dividers are analyzed in terms of their inherent errors and comparative advantages. Both isolated transformer and autotransformer circuits are treated; in each case, the voltage transformer functions are given and source impedance is assumed to be zero. Errors are mainly caused by voltage drop in the windings, leakage current between windings, and the effect of external loads. The analysis provides a method for optimum choice of divider design, based on the degree of accuracy required.
Transl. by B.E.S.

N70-23966# Akademiya Nauk URSR, Kiev.
SELECTING A METHOD FOR COMPENSATING AUTOMATIC ac BRIDGES
V. P. Karpenko and I. S. Serikov *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 98–108 In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Methods for compensating the errors in dual ac bridges are proposed. The primary source is the resonant effect which occurs from the continuation of distributed capacitance plus winding inductance in transformer-coupled circuits. Dual transformer bridges are assumed for which the relative errors are separately evaluated in terms of primary and secondary inductive reactance, and distributed capacitive reactance.
Transl. by B.E.S.

N70-23967# Akademiya Nauk URSR, Kiev.
METHODS OF LINEARIZING THE TRANSFER CHARACTERISTICS OF ac TO dc VOLTAGE CONVERTERS
A. D. Nizhenskiy *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 109–115 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Several diode ac to dc converter circuits are evaluated in terms of linearity of response. The test design is a linear detector, for which experimental data are given. Tabulation of rectification constants and linearity error are given for the linear detector and two less suitable designs. Input signals were held below two volts.
Transl. by B.E.S.

N70-23968# Akademiya Nauk URSR, Kiev.
PHASE METHOD OF MEASURING FLUX DENSITY IN CONSTANT MAGNETIC FIELDS USING RELUCTANCE EFFECT
Ye. A. Andriyevskiy, S. G. Taranov, and Yu. M. Panchishin *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 116–123 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

An unbalanced bridge method is proposed for measuring flux density in a constant magnetic field. Field strength is determined from relative phase shift in the voltages of two branches of the bridge. The design is useful for strong magnetic fields in which sensors of the Hall type are inaccurate. The bridge does not depend on a highly stabilized supply voltage and may be remotely operated in a telemetry system.
Transl. by B.E.S.

N70-23969# Akademiya Nauk URSR, Kiev.
ANALYSIS OF COMPENSATED MULTIPLIERS BASED ON THE HALL EFFECT
S. G. Taranov and V. V. Brayko *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 124–134 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Multiplier circuits based on Hall elements are analyzed. Circuit errors are tabulated, including systematic error, and errors in constant and variable cofactors. Rigorous and simplified expressions for multiplier outputs are given for each circuit discussed. InSb or InAs elements are recommended for current multipliers because of their low input impedance.
Transl. by B.E.S.

N70-23970# Akademiya Nauk URSR, Kiev.
CORRECTING THE DYNAMIC PROPERTIES OF PHOTOELECTRIC FLUXMETERS
S. A. Labudev *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 135–141 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Feedback circuits for correcting photoelectric fluxmeter readings are examined. Transfer functions are given for each variant and the relative advantages of the designs are analyzed. Oscillograms of circuit response to a step change in measured flux show that transient oscillations can be effectively suppressed.
Transl. by B.E.S.

N70-23972# Akademiya Nauk URSR, Kiev.
ON THE EFFECT OF MAGNETIC CIRCUIT CONFIGURATION ON THE MAGNITUDE OF FIELD STRENGTH IN A PERMEAMETER AIR GAP
N. Ye. Fevraleva and A. B. Andreychuk *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 151–157 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Magnetic circuit configurations for permeameters are considered and expressions for measurement parameters are given. Measurement of field strength in the meter air gap was done at varying values of gap width and excitation currents up to 1080 ka/m. Steady state and pulsed magnetizations were used, on generally low-permeability materials; pulse current durations of 7.5 millisec and 120 millisec are mentioned. Tabulated data are given relating excitation current and air gap field strength for the steady state and pulsed cases. Transl. by B.E.S.

N70-23973# Akademiya Nauk URSR, Kiev.
TESTING A TWO-POLE ROTOR IN A DEVICE WITH PARTIALLY CLOSED MAGNETIC CIRCUIT
Ye. A. Andriyevskiy and Ya. F. Nepokrytyy *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 158–164 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Testing coercivity on a two-pole magnetic rotor is discussed. Rotors were of magnetically isotropic YuND 4 alloy, and were tested in three different orthogonal positions between the excitation pole pieces. Variations in coercivity as a function of rotor angular position are tabulated for four rotor configurations, using Hall elements as sensors. Results show that coercivity varied only slightly with rotor position. Measurement error with the technique described is about 3%. Transl. by B.E.S.

N70-23974# Akademiya Nauk URSR, Kiev.
ERRORS IN THE PULSE-INDUCTIVE METHOD FOR SUPPLYING A MAGNETIZING DEVICE FROM A RECTIFIER
S. T. Usatenko *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 165–170 refs In RUSSIAN (See N70-23951 11-09) Avail: CFSTI

Errors in pulsed magnetic field metering devices are considered for the case of a rectified power supply. Test oscillograms illustrate the effect of supply current ripple on magnetic parameter measurements. Test show that three-phase full-wave rectification causes the least systematic error in pulsed-field devices, assuming that large current sources such as a capacitor bank or a water-generator set are not available. Transl. by B.E.S.

N70-23976# Akademiya Nauk URSR, Kiev.
CIRCUITS FOR CORRECTING MEASUREMENTS IN NON-COMMUTATED METHODS OF TESTING LOW-PERMEABILITY MATERIALS
S. T. Usatenko *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 179–186 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Correcting for demagnetization current error is analyzed for the general case where the test specimen is placed in a test magnet air gap. Several compensating circuits are suggested, including types with Hall sensors. Advantages of the circuits are examined in terms of correction accuracy, complexity, and physical dimensions. Transl. by B.E.S.

N70-23982# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
THE ANALYSIS OF SYNCHRONIZED OSCILLATORS BY USE OF PHASE-LOCKED-LOOPS Summary Report
Leon W. Couch and Raymond C. Johnson 6 Oct. 1969 50 p refs
(Contract DAAG39-67-C-0077)
(AD-698511; HDL-0077-14; SR-69-4) Avail: CFSTI CSCL 9/5

The synchronization behavior for an electronic oscillator is examined by the use of a first-order phase-lock-loop (PLL) model for the oscillator. A Hilbert transform relationship is obtained which relates a known beat waveform (between the oscillator and a locking-signal) to the other possible beat waveforms (as described by Huntoon and Weiss and others). The equivalence between an oscillator and a PLL is established in terms of equivalent locking characteristics. Using this PLL model, beat waveforms are obtained for some specified locking signals. The locking phenomenon between two oscillators is also examined by the use of a PLL model for each oscillator. Finally, the locking characteristics for an oscillator which is frequency-modulated by a feedback signal is studied, and it is shown that the lock-in width may be increased over that for the oscillator without feedback, or, alternately, the lock-in width may be reduced to zero. This is accomplished with relative ease by adjustment of the feedback parameters. All of the results of this report are verified experimentally as well as theoretically. Author (TAB)

N70-24050# Lockheed Missiles and Space Co., Palo Alto, Calif.
SIMULATED RAMAN RADIATION OF PbSe DIODES AT 77 K
S. P. Chashchin et al 19 Sep. 1969 1 p refs
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Stimulated Raman radiation was obtained in PbSe diodes which were produced from n-type PbSe single crystals by diffusing pure selenium in an evacuated-welded quartz ampoule to obtain p-n-junctions. The threshold of the emissions was determined, and corresponds to a wavelength of 0.17 ev photon energy indicating the predominance of band-band transitions. F.O.S.

N70-24096# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PRINCIPLES OF WIDEBAND UNIDIRECTIONAL PIEZOELECTRIC TRANSDUCERS
Richard A. Waldron 4 Nov. 1969 26 p refs
(Contract AF 19(628)-5167)
(AD-698750; TN-1969-54; ESD-TR-69-333) Avail: CFSTI CSCL 9/1

By interweaving the fingers of an interdigital transducer with an earthed meander line and supplying different voltages, in different phases, to the fingers, a variety of interesting performances may be achieved. Two unidirectional transducers and a diplexing transducer are described as examples of the technique. In order to achieve the performances that theory indicates, a number of technical problems need to be overcome. These problems are pointed out and approaches to their solution are suggested. Author (TAB)

N70-24129# New York Univ., N.Y. Research Div.
THE ELECTRONIC SENSOR, VOLUME 1
Henry S. Lax and Gregory de Santis Nov. 1969 77 p refs
(Contract N00039-68-C-3607)
(AD-699147) Avail: CFSTI CSCL 9/3

The electronic sensor is defined according to Mil-Std-1326 as Circuitry and related hardware located within the prime equipment for the purpose of providing a suitable test signal for the automatic test equipment (ATE) .... This report reflects the state-of-the-art and present availability of such sensors by an analysis of the special characteristics of the electronic sensor and by providing a collection of more than 250 individual sensor data sheets (both specially developed and standard off-the-shelf items) with descriptions and many block and circuit diagrams. Special consideration is given to sensors which meet the requirements of Mil-Std-1326 but the

report is not limited to such sensors. To help the designer to select suitable sensors, sensor tabulations according to parameters and ranges are provided. Author (TAB)

N70-24138# New York Univ., N.Y. School of Engineering and Science.
THE ELECTRONIC SENSOR, VOLUME 2
Henry S. Lax and Gregory de Santis Nov. 1969 207 p
(Contract N00039-68-C-3607)
(AD-699148) Avail: CFSTI CSCL 9/3

Electronic sensors for sampling and continuous monitoring of various parameters such as voltage, current and frequency are described on more than 250 individual data sheets. Both specially developed sensors and standard off-the-shelf items for built-in test applications are dealt with. To help the designer to select suitable sensors, sensor tabulations according to parameter and range are provided. Author (TAB)

N70-24189# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REVERSING BINARY-CODED-DECIMAL COUNTER WITH INCREASED RESPONSE SPEED
V. N. Shenderovich 13 Aug. 1969 12 p refs Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Upr. (USSR), no. 2, 1967 p 28–30
(AD-699223; FTD-HT-23-29-69) Avail: CFSTI CSCL 9/5

The reversing binary-coded-decimal counter uses a comparatively simple circuit and has increased resolution, the latter defined only by the response speed of the trigger cells. A distinctive feature of the counter is the fact that two different modifications of the self-complementary binary-decimal 2421 code are used in it for addition and subtraction. On a change in counting direction, it switches automatically from one modification to the other. Author (TAB)

N70-24244# Harry Diamond Labs., Washington, D.C.
LOW TCR FILM RESISTORS FOR CIRCUIT APPLICATIONS
William E. Isler and Lester A. Kitchman Oct. 1969 38 p refs
(AD-699344; HDL-TR-1432) Avail: CFSTI CSCL 9/1

The report concerns vacuum-deposited resistive films for possible use in circuits requiring low-temperature-coefficient components. Films were deposited by both ordinary and flash techniques from an alloy of Ni, Cr, Cu, and Al with a TCR in the bulk of plus or minus 5 ppm/C. The nonflash experiments showed that the film TCRs improved from +250 ppm/C for a film Ni/Cr ratio of 1.3 to +20 ppm/C for a ratio of 3.4. Films deposited onto Corning 7059 glass were more stable than those deposited onto soda-lime glass. The composition for the nonflash films was not so reproducible as that for the flash-deposited films, which were characterized by negative TCRs for sheet resistivities higher than 100 ohms/square. The flash technique was of the particle by particle type, which results in films having appreciable amounts of entrapped gases. This suggests another method of controlling TCR since resistance values decrease and the TCRs increase as gases are baked out. Author (TAB)

N70-24372*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DC REGULATOR FOR LOW PRESSURE MERCURY LAMPS (PEN-RAY)
D. Huguenin Paris ESRO Jan. 1968 10 p
(NASA-TM-X-62839; ESRO-TM-145) Avail: CFSTI CSCL 09A

A new type of power supply is described, which provides a stable DC voltage, free from any 120 cps ripple due to the mains. One possible application is its use in the photometry of very weak light sources. After a brief general description, the electrical specifications, circuit description and utilisation of the power supply are discussed, and a parts list, together with a schematic diagram, are given. Author (ESRO)

N70-24414 Stevens Inst. of Tech., Hoboken, N.J.
INVESTIGATION OF JUNCTION GEOMETRY EFFECTS LIGHT PROPAGATION IN MULTILAYER SEMICONDUCTOR STRUCTURES
John Hugh Carran (Ph.D. Thesis) 1969 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-21284

Lasing along curved paths, guided by curved junctions is discussed. The effects of junction curvature on injection laser diode performance were investigated. Propagation of light along resonant paths in active media was considered for active media curvature along the direction of light propagation and also for active media curvature normal to the direction of light propagation. This involves formulating Maxwell's equations in cylindrical coordinates for a three layer lossy dielectric sandwich model. A solution of these equations by digital computer indicates that the additional losses due to curvature become significant at different critical radii for the two types of curvature. When parameters appropriate for diffused gallium arsenide laser diodes are used, the critical radius for curvature along the path of propagation is approximately two orders of magnitude larger than the critical radius for the normal direction. Diffused gallium arsenide devices with curved active regions were fabricated and tested. Dissert. Abstr.

N70-24419 Michigan State Univ., East Lansing.
NUMERICAL ANALYSIS OF MAXIMUM MICROWAVE POWER FROM A TUNNEL-DIODE OSCILLATOR
Chandrakant Bhailalbhai Patel (Ph.D. Thesis) 1969 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20909

The large signal operation of a tunnel-diode oscillator circuit is examined with the object of delivering maximum fundamental power to the load. The exact analysis of the circuit operation results in a highly nonlinear, third-order and second-degree differential equation. The circuit can also be described by means of a set of first order, nonlinear differential equations—its mathematical model. Using a digital computer, this set of equations is numerically integrated in the time domain using a fourth-order Runge–Kutta scheme. The time domain solution retails all significant harmonics, and frequency domain analysis can then be used to evaluate the harmonic content. This method of solution can be easily extended to study the effects of voltage-dependent elements such as the tunnel diode junction capacitance. Two specific configurations of load circuit were used for most of the computer analysis work. Dissert. Abstr.

N70-24457 Kansas State Univ., Manhatten.
SENSITIVITY ANALYSIS AND LIAPUNOV STABILITY THEORY APPLIED TO POWER SYSTEM ANALYSIS
Richard Dana Teichgraeber (Ph.D. Thesis) 1969 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-21145

Techniques of sensitivity analysis and Liapunov stability theory are used to study, via a digital computer, the effects of parameter variation on the performance of a power system under the condition of a transient disturbance. Results are presented for a numerical example of a one machine-infinite bus power system. The techniques for performing a dynamic sensitivity analysis of a power system on a digital computer are described. This analysis yields information about the sensitivity of the machine rotor angle to parameter variations in the form of oscillatory dynamic sensitivity coefficients which are functions of time. These coefficients indicate that the rotor angle is most sensitive to variations in machine

damping, followed in decreasing order of influence by terminal voltages, equivalent admittance, mechanical input power, and machine inertia. Dissert. Abstr.

N70-24590 Ohio State Univ., Columbus.
A SILICON DIODE MOSAIC ARRAY VIDICON TUBE FOR X-RAY IMAGING
Benjamin Franklin Jacoby (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-22152

The behavior of semiconductor p-n junctions to radiation of a wide variety was examined relative to employment of junction arrays as the target element in electron beam image tubes. Because of convenience the standard vidicon structure was selected for experimental evaluation and silicon was used as the semiconductor for target construction. A theoretical treatment of the interactions of X-rays with matter is given and it is shown that the production of electron-hole pairs in the silicon diode vidicon target is basically a two step process. The X-rays interact with the silicon through photoelectric, Compton or pair production mechanism to produce energetic electrons, and these electrons in losing kinetic energy by passage through the silicon target material create electron-hole pairs. Approximate theoretical expressions are developed for the average number of pairs per photon produced in a single vidicon target as a function of target thickness and incident photon energy and the results are plotted in the energy range of 10 KeV to 10 MeV for 1 cm, .1 cm, .01 cm, and .001 cm thick targets. The treatment includes the effect of electron range in the silicon target material but neglects electron straggling by assuming forward scattering. Dissert. Abstr.

N70-24613 Polytechnic Inst. of Brooklyn, N.Y.
TWO-VARIABLE SYNTHESIS OF RESISTIVELY TERMINATED CASCADES OF LOSSLESS TRANSMISSION LINES, SERIES INDUCTORS AND SHUNT CAPACITORS AND MINIMUM GYRATOR SYNTHESIS OF CERTAIN LUMPED LOSSLESS n-PORTS
Gary Davit Ott (Ph.D. Thesis) 1969 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-20356

Necessary conditions are derived for the driving point impedance function of a resistively terminated cascade of equal lengths of lossless transmission line, series inductors and shunt capacitors. Several approaches are presented which tend to indicate that the conditions are also sufficient. The problem of realizing an arbitrary rational n x n regular para-unitary matrix, as the scattering matrix of a lossless n-port containing the minimum number of ideal gyrators is considered. It is shown that a minimum gyrator synthesis is always possible for the special class of matrices having a skew-symmetric part which is nonsingular for all p = j omega, including p = infinity. A nontrivial numerical example of the synthesis technique is presented in an appendix. In addition, techniques for the minimum gyrator synthesis of arbitrary 2 x 2 and degree two n x n regular para-unitary matrices are presented. Dissert. Abstr.

N70-24617# California Univ., Livermore. Lawrence Radiation Lab.
MAGNETIC PULSER FOR PAM MULTIPLEXED INSTRUMENTATION POWERED AND TIMED FROM 10 KHZ 3 PHASE AC
Kris Aaland and Glynn A. Pence Apr. 1969 28 p ref Presented at the Workshop on Appl. Magnetics, Washington, D.C., 21-23 May 1969 Sponsored by AEC
(UCRL-71574; CONF-690546-1) Avail: CFSTI

An all magnetic pulser for multiplexing 80 transducers was developed. Three groups power 240 transducers with a 0.3 microseconds wide pulse in a repetitive pattern every 50 microseconds, hence has a combined group rate of 4.8 × 1 million amplitude modulated pulses per second. Power and timing are provided by a 10-kHz, 3-phase ac line. The pulse forming network, connected between part of the magnetic pulser and transducer it drives, is effected by a modified Melville line which incorporates a 30-meter long transmission line. The magnetic pulser provides reliable operation in a hazardous (radiation) environment and replaces an earlier unit which required thousands of transistors. The magnetic pulser is a further step in the evolution of design using saturable reactors. Author (NSA)

N70-24635 California Inst. of Tech., Pasadena.
DERIVATION AND INTERPRETATION OF A GENERALIZED CHARGE-CONTROL THEORY AND RECIPROCITY FOR A BIPOLAR TRANSISTOR
Edward Ted Grinthal (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-19598

The charge-control relations are rigorously derived from the carrier transport and continuity equations for a bipolar transistor with an arbitrary three-dimensional geometry, arbitrary base impurity distribution, arbitrary recombination mechanisms (including spatial nonuniformity), and for both low and high injection levels. A one-to-one correspondence is maintained between internal processes and the charge-control parameters, so that conceptual understanding of, and insight into, device operation is enhanced. In the absence of recombination, the average carrier velocity is used to obtain the average carrier transit time across the base region. The current is then obtained as the ratio of injected base charge to the average transit time. In the presence of recombination, the injected carriers are divided into two groups according to whether they recombine or are collected. Dissert. Abstr.

N70-24728*# Newark Coll. of Engineering, N.J.
ANALYSIS OF SECOND BREAKDOWN Final Report
R. P. Misra 1969 41 p
(Contract NAS8-21286)
(NASA-CR-102501) Avail: CFSTI CSCL 09A

A secondary breakdown analysis of transistors showed that most power transistors get into second breakdown at a lower current when the temperatures are very low, however, some transistors do not follow this behavior. There is also a very mild correlation between electrical noise and early breakdown. S.S.

N70-24760# California Univ., Livermore. Lawrence Radiation Lab.
METHOD OF UTILIZING SPARK-GAP FOIL SWITCHES IN DETERMINING DETONATION VELOCITIES OF SOLID EXPLOSIVE MATERIALS
Gary W. Carter 11 Aug. 1969 10 p refs
(Contract W-7405-eng-48)
(UCRL-50697) Avail: CFSTI

The application and method of applying spark-gap foil switches to high explosives are discussed. Although the use of spark-gap switches is not new, the recent development of etched copper/polyester switches makes possible simple installations on solid high explosives for determining detonation velocities. The spark-gap switches are also adaptable for use on explosives with irregular configurations. Author (NSA)

N70-24831# University Coll., London (England). Mullard Space Science Lab.
ELECTRONIC DESIGN FOR SATELLITE APPLICATIONS
J. A. Bowles *In its* Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 44 – 50 (See N70-24826 11-30)
Avail: CFSTI

The design of electronic equipment for satellite applications and the effects of temperature, radiation damage, vibration levels, and interference are discussed. The importance of sub-system redundancy is stressed. ESRO

N70-24894 Polytechnic Inst. of Brooklyn, N.Y.
THE CYCLOTRON KLYSTRON
Craig M. Garretson (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-20333

The operation of the cyclotron klystron may be understood as follows. The sheet beam of electrons is emitted from the cathode, and, under the action of electrostatic and magnetostatic fields, perpendicular to each other and to the drift velocity of the beam, is caused to move through an input cavity where it is velocity modulated, thence through a drift region where the bunching of the beam is optimized, then through an output cavity where energy is extracted from the beam, and finally to a collector. This overall action is reminiscent of a conventional klystron except for the use of a sheet beam. The use of perpendicular electrostatic and magnetostatic fields, however, causes the electrons in the beam to execute cycloidal motion, the rotational component of which can have its angular frequency adjusted by the magnetostatic field to coincide with that of the rf field, thereby permitting a cumulative interaction to occur between the electrons and the rf fields. Dissert. Abstr.

N70-24936 Oregon Univ., Portland.
ON OUTPUT STATISTICS OF NONLINEAR DEVICES: THIRD AND HIGHER ORDER INFORMATION, QUADRIPHASE CARRIER RECONSTRUCTION, ANALYSIS OF POINT PROCESSES
Richard Joseph Sherman (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19914

This thesis deals with the output statistics of nonlinear devices. It develops the classical output autocorrelation function in two dimensions and extends the theory to three and four dimensions. Closed form solutions for the output correlation function in two and three dimensions are given for the full- and half-wave rectifier families while a series solution with numerical results is presented in the case of the smooth limiter in four dimensions. A nonlinear device used to provide a coherent reference signal in a digital phase modulation system is analyzed and results presented in terms of average error rate performance degradation. Finally, the problem of determining the average number of times per unit of time that a process consisting of a sinusoidal signal plus Gaussian noise transgresses a fixed level or has summits above or below a fixed level is investigated. Dissert. Abstr.

N70-24938 Polytechnic Inst. of Brooklyn, N.Y.
TUNABLE FILTERS FOR THE VISIBLE AND INFRARED SPECTRAL REGIONS
Richard Jules Kapash (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-20341

The primary objective in this work was to examine both experimentally and theoretically the properties of an electronically tunable filter for the visible and infrared spectral regions. The design was based upon the Frustrated Total Reflection (FTR) filter. The basic FTR filter is a Fabry-Perot structure in which the partially reflecting metal films are replaced by low refractive index dielectric layers. These layers exhibit a high reflectance to waves incident at angles greater than the critical angle for total reflection. The structure investigated is an FTR filter with an air gap (low refractive index layer) introduced in the center of the resonant layer. The resulting filter has two resonant layers which are coupled by the evanescent wave in the air gap and two resonant wavelengths whose positions change with variations in the size of the air gap. For zero air gap, the two resonances are widely separated; but as the air gap is increased, the resonances move together eventually merging into a single band. Dissert. Abstr.

N70-24997 Polytechhic Inst. of Brooklyn, N.Y.
THE QUANTIZED FREQUENCY LOCKED LOOP FM DEMODULATOR
Manfred Guenther Unkauf (Ph.D. Thesis) 1969 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-20380

The Frequency Locked Loop FM Demodulator, FLL, is a new type of FM demodulator which uses the correlation between the instantaneous amplitude and frequency deviation of a noisy FM signal to extend the noise and/or error threshold exhibited by the conventional FM discriminator. This threshold extension is accomplished by the ability of the FLL to suppress gross frequency disturbances, noise clicks, which occur in the output of the FM discriminator for low signal to noise ratios. An improved version of the FLL is presented and analyzed. An expression for the signal to noise ratio performance of the baseband version of the quantized FLL is based on a Gaussian noise and Poisson distributed click model for the FM discriminator noise. Dissert. Abstr.

N70-25099# Eidgenossische Technische Hochschule, Zurich (Switzerland).
SPONTANEOUS FLUCTUATION PHENOMENA IN VERY HIGH FREQUENCY AND ULTRAHIGH FREQUENCY REGIONS OF FIELD EFFECT TRANSISTOR [SPONTANE SCHWANKUNGSERSCHEINUNGEN IN FELDEFFEKTTRANSISTOREN IM VHF UND UHF BEREICH]
Alex Max Leupp (Ph.D. Thesis) 1968 113 p refs In GERMAN *Its* Diss. No. 4274
Avail: CFSTI

The noise behavior of field-effect transistors especially in the VHF and UHF region is investigated. The FETs are mostly used in the pinch off region therefore the noise figures are determined in this region only. The main sources of noise in a junction FET and in a MOSFET (channel noise, induced gate noise) are calculated using the same procedure for both types. For the MOSFET the influence of the substrate is also considered. The noise sources are introduced in a simplified FET equivalent circuit from which the noise figures can be computed. With a noise measuring test setup having a range from 0.1 to 1 GHz the noise figures have been determined experimentally. A very good coincidence is shown between theoretical and experimental results. For low noise design a quick evaluation of the optimum source admittance is of great interest, so an approximative method for their determination is given. Author

N70-25128# Stanford Research Inst., Menlo Park, Calif.
EXPLODING WIRE DETONATORS: RESISTIVITY FUNCTIONS AND INITIATION CRITERIA FOR CIRCUIT CALCULATIONS, ISSUE 2 Work Manual
J. H. Blackburn and G. M. Muller 10 Jun. 1969 281 p Sponsored by AEC Prepared for Sandia Corp.
(SC-CR-69-3204) Avail: CFSTI

This manual is divided into three sections. Section one contains brief descriptions of the firing circuits, an index to the shots, copies of analysis sheets, and a discussion of the redetermined circuit parameters. A table of linear relations among electrical quantities at burst and copies of the programs for the use of resistivity functions are contained in the second section. The last section covers detonator threshold studies. Author (NSA)

N70-25158# Akademiya Nauk URSR, Kiev.
INCREASING THE PRECISION AND AUTOMATING ELECTRICAL AND MAGNETIC MEASURING DEVICES
N. Z. Lapteva, ed. 1968 188 p refs In RUSSIAN
Avail: CFSTI

Some problems of measuring technology are considered, including design of electromagnetic measuring devices such as balanced bridges, phase sensitive equilibrium indicators, phase shift

meters, and magnetic measuring circuits. Methods are proposed for error analysis of electrical and magnetic measuring apperatusses, with emphasis on automation of the devices. For individual titles, see N70-25159 through N70-25186.

N70-25160# Akademiya Nauk URSR, Kiev.
SOME CIRCUITS OF MEASURING POWER CONVERTERS
V. S. Skryabinskiy and Yu. V. Tsvetinovich *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 15-20 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The defects of wattmeters, used presently to measure the output of electrical circuits, include imprecision and low speed. To counteract these defects highly precise measuring power converters are used. These converters permit the integration of the output for any given time period which is useful when measuring the power in circuits with distorted shapes for current and voltage values. When precision and stability of the conversion factor are the primary criteria, dynamic converters are preferred. A description is presented for several circuits for constructing dynamic measuring power converters. The necessity is shown for introducing phase detection in the circuits of the automatic device in order to improve the metrological and operational properties of the converters.
Transl. by H.W.

N70-25161# Akademiya Nauk URSR, Kiev.
MEASUREMENT WITH TIME COMPRESSION
B. G. Kaduk and V. V. Sadovskiy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 21-23 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The method of time compression is used in the extremely low frequency range for measuring voltages, and also during measurements of the correlation phase. In addition to these advantages the authors studied the possibility of applying the method of time compression to wide band signals. An evaluation of the minimum relative frequency of selection is given.
Transl. by H.W.

N70-25162# Akademiya Nauk URSR, Kiev.
MEASUREMENT OF EXTREMELY LOW FREQUENCY VOLTAGES USING TIME COMPRESSION DEVICES
B. G. Kaduk *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 24-26 In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

In order to measure the effective and average values of voltage, integration must be accomplished in a time span equal to 5-8 periods of the basic harmonic of the measured signal. When measuring voltages of extremely low frequencies a large integration constant increases the measurement time considerably. Lowering the measurement time to a value equal to the period of the basic harmonic is permitted by using the method of preliminary time compression. This means that the time scale of a sector of the signal is compressed. However, additional errors of conversion arise when using this method. Their basic cause is that the measurement is conducted for the final sector of the signal and not for the initial signal. The method of preliminary time compression of a signal more effectively increases the speed of the measuring equipment in the extremely low frequency range with an error which is permissible for technical measurements.
Transl. by H.W.

N70-25163# Akademiya Nauk URSR, Kiev.
SELECTION PROPERTIES OF NARROW BAND SELF TUNING AMPLIFIERS
A. D. Nizhenskiy and N. M. Tsareva *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 27-32 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The possibility of stabilizing the amplification factor of a narrow band amplifier is considered by compering the input and output voltages of the amplifier and the automatic fine tuning of the amplification factor with the difference signal. The equation of the statics of the amplifier is analyzed and the relationship of the amplifier pass band to the magnitude of the self-tuning coefficient is determined.
Transl. by R.B.

N70-25164# Akademiya Nauk URSR, Kiev.
THE EFFECT OF HIGHER HARMONICS ON MEASUREMENT PRECISION IN PHASE METERS WITH FREQUENCY CONVERSION
V. Ya. Dremlyuga *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 33-37 In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

Based on the analysis of the effects of the higher harmonics the following conclusions are made: (1) The heterodyne method of frequency conversion permits the practical exclusion of the angular error arising from the effect of the higher harmonics. The main defect of this method is the angular error arising from the connection between the channels through the common heterodyne. (2) The method of converting frequencies using single band modulation permits conversion of the phase relationships of input voltages into stabilized frequency. (3) The method of converting frequency using upper frequency filters produces highly stabilized IF, considerable reduction of errors from higher harmonics, and exclusion of the errors arising from the second side band. An important advantage of this method is the elimination of tuning operations by frequency and amplitude.
Transl. by H.W.

N70-25165# Akademiya Nauk URSR, Kiev.
ERRORS OF TWO-ELEMENT PHASE METERS IN THREE-PHASE ASYMMETRIC SYSTEMS
V. A. Khomyak *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 38-45 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A method is discussed for analyzing the relationships of the errors of three-phase two-element phase meters to asymmetry. It is shown that, in a number of cases, these errors exceed the allowable precision number for the devices used. Recommendations are presented for the selection of circuits for three-phase phase meters.
Transl. by H.W.

N70-25166# Akademiya Nauk URSR, Kiev.
MEASUREMENT CIRCUIT OF AN AC DIGITAL BRIDGE FOR MEASURING THE PARAMETERS OF INDUCTION COILS
F. B. Grinevich *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 46-52 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A frequency-independent circuit for a digital bridge with narrow inductive coupling is described. The bridge is used to determine the inductance and Q-factor of the controlled object according to an equivalent series circuit. A theoretical analysis of the operation of the measurement circuit is presented. Losses of the reference coil are compensated by a small rotation of the voltage phase which acts in the reference coil circuit, and also by the introduction of low capacitance capacitors, connected in parallel to resistors which serve to balance the bridge according to the Q-factor.
Transl. by H.W.

N70-25167# Akademiya Nauk URSR, Kiev.
THE GEOMETRY OF WINDINGS OF TRANSFORMER BRIDGES
A. I. Novik *In its* Increasing the Precision and Automating Elec.

and Magnetic Measuring Devices 1968 p 53-59 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The effect of the configuration of windings and their parts on the degree of their susceptibility to external magnetic fields is studied. Since, when lowering the susceptibility, there is a simultaneous lowering of its radiating capacity, this to an equal degree relates to the indicator windings of current comparators and to the generator windings of voltage transformers. The constructions described were checked experimentally to the degree of susceptibility to the external fields. A test showed that with efficient winding geometry, wound on ring ferrite cores with rectangular cross section, their susceptibility can be lowered several times in comparison to the usual single layer windings. Transl. by H.W.

N70-25168# Akademiya Nauk URSR, Kiev.
AN INDUCTIVE VOLTAGE DIVIDER WITH INVERSE RATIO OF THE OUTPUT VOLTAGE TO THE NUMBER OF TURNS IN THE CONTROL WINDINGS
Yu. V. Bratus and V. P. Karpenko *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 60-66 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The discreteness and precision of separation of the output voltage of such a divider depends on the number of single-turn transformers, plus the number and ratios of the turns in the transformers. The precision of separation is also affected by various additional factors: the coupling between the windings, the mutual load of the single-turn transformers, spurious couplings, the external load of the output winding, etc. It is shown that, with the correct selection of the winding and core parameters for the single-turn transformers, an extremely high precision of voltage division can be attained. Transl. by H.W.

N70-25169# Akademiya Nauk URSR, Kiev.
A SQUARE-LAW INDICATOR NONSENSITIVE TO THE AMPLITUDE OF INPUT VOLTAGE
Ye. N. Motora and V. I. Skripnik *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 67-73 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The circuit of a device, designed for the precise indication of the 90-degree phase shift between the vectors of compared voltages, is described. The circuit under study ensures precise monitoring of the quadrature of the compared voltages for the case when the relation of their amplitudes is not more than 100, since known methods either do not provide such precision or they permit precise monitoring when the ratio of the amplitudes of the compared voltages is not more than 1 to 3. Transl. by H.W.

N70-25170# Akademiya Nauk URSR, Kiev.
AUTOMATIC DIGITAL BRIDGE FOR MEASURING THE PARAMETERS OF COILS WITH FERROMAGNETIC CORES
V. P. Belousov, Yu. V. Bratus, V. P. Karpenko, and I. S. Serikov *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 74-79 In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

Double bridges with inductively connected arms have been developed for measuring the components of complex resistances in a parallel circuit and for controlling the properties of the measured object. An automatic digital bridge was developed with phase sensitive detection, which ensures measurement of the parameters with given limits of induction and with a given Q-factor for certain supply voltage frequencies. The balancing of the bridge takes place along the two components of complex resistance. If the bridge reaches equilibrium in one of these components earlier than in the other, the system will perform oscillations along the point of equilibrium up to the complete balancing of the bridge for the two components. Transl. by H.W.

N70-25171# Akademiya Nauk URSR, Kiev.
A FUNCTIONAL CONVERTER WITH APPROXIMATELY SQUARE-LAW VOLT-AMPERE CHARACTERISTICS
V. S. Skryabinskiy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 80-88 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

Static converters with fragmented linear approximation are very promising from the point of view of producing functional converters with square-law volt-ampere characteristics. A method is proposed for their design with the characteristics presented in the form of a broken line. A relationship is derived between the precision of conversion and the number of linear sections of the curve. Transl. by H.W.

N70-25172# Akademiya Nauk URSR, Kiev.
PHASE METER FOR MEASURING THE FREQUENCY OF SERIES RESONANCE AND THE Q-FACTOR OF CRYSTAL RESONATORS
M. S. Yevdokimov and Yu. A. Skripnik *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 89-96 In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The high precision of the phase method for measuring series resonance frequency in comparison to the amplitude method is caused by the fact that the curvature of measuring the phase shift with the frequency is greatest at the resonance frequency. In the case of small losses in crystal resonators, even insignificant relative changes in frequency create actual changes in the phase shift. The phase method of measuring the Q-factor of crystal resonators is based on the minimal phase properties of the resonator frequency characteristics at which the transmission band boundary corresponds to the phase shift between the input and output voltages of the excited resonator. A block diagram of a commutative phase meter is presented. Basic relationships are given which indicate the possibility of measuring phase shifts by the null method within a wide range of frequencies. Transl. by H.W.

N70-25173# Akademiya Nauk URSR, Kiev.
SINGLE CHANNEL AUTOMATIC COMPENSATION PERIODIC COMPARATOR DEVICE FOR MEASURING PHASE INSTABILITY
Yu. A. Skripnik and N. A. Yaremchuk *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 97-102 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The device consists of a commutative phase modulator, a compensating phase shifter, a summator, and a single channel comparator circuit. This device measures the phase instability of four-terminal electrical networks. The precision of the device is affected by the commutative converter, summator, attenuator, and phase shifter. However, by using passive elements to make these subassemblies, high precision of measurement can be attained. The circuit diagram for a dummy model of the phase shifter is explained in detail. Transl. by H.W.

N70-25174# Akademiya Nauk URSR, Kiev.
SELF-ADJUSTING MEASURING AMPLIFIERS OF EFFECTIVE VOLTAGE VALUES
A. D. Nizhenskiy and I. V. Yanovskaya *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 103-109 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The problem of measuring small effective voltage values

can be solved by means of periodic comparison of the effective values of the input and, in part, the output voltages and retuning the amplification factor by the difference signal in relation to the shape of the input signal, and the frequency and nonlinear distortions induced by the amplifier. Amplifiers of this type are called self-adjusting measuring amplifiers. An analysis is presented of the effect of instability of the amplification factor of an amplifier on the results of measurements as a function of the value of the self-adjusting factor. Possibilities are shown for eliminating the effect of the irregularity of the amplitude-frequency characteristics of the ac voltage divider on the results of measurement. Transl. by H.W.

N70-25175# Akademiya Nauk URSR, Kiev.
ANALYSIS OF THE OPERATION OF A LIMITING AMPLIFIER WITH CORRECTION OF THE LIMITING LEVELS
V. Ya. Dremlyuga *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 110–114 In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The circuit of the limiting amplifier permits reduction of Nyquist errors. This is achieved by excluding the interstage bypass capacitors, by using constant-component correcting emitter repeaters, and by introducing direct current negative feedback. The characteristic feature of the circuit is that symmetrical limiting of the signal occurs relative to the working point of the amplifier. This circuit has definite advantages over the two-pole circuit presently used. These advantages include: 1) errors in the low frequency range are reduced to a minimum; 2) the error from even and odd harmonics located in the push-pull phase are excluded; 3) operational malfunctions are absent in the case of measured angles close to 180 degrees; and the circuit may be used in single channel phase meters. Transl. by H.W.

N70-25176# Akademiya Nauk URSR, Kiev.
DEVICE FOR CONVERTING DC INTO AC VOLTAGE WITH SMALL NONLINEAR DISTORTIONS
V. V. Brayko, B. A. Marshalenko, and V. P. Tavrovskiy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 115–120 ref In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A device based on the use of the Hall effect is described for converting voltage with a strictly sinusoidal shape. A short analysis of the converter operation is given. The technical characteristics of a mock up of the device are presented. Transl. by H.W.

N70-25177# Akademiya Nauk URSR, Kiev.
ALTERNATING CURRENT AND VOLTAGE AMPLITUDE STABILIZERS
V. V. Brayko *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 121–127 ref In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

An analysis of the operation of a circuit is presented, which permits highly precise stabilization of the amplitude of the output current (or voltage) without distortion of the shape of the output signal curve. In this manner, this circuit can serve as a source of current or voltage stabilized by amplitude and permits a change in the load and generator signal resistors within wide limits. The relative error of the transmission factor and the relative error of the amplitude of the input voltage are studied in connection with the stabilizer. The stabilizer circuit was used for supplying low-ohm Hall generators. Transl. by H.W.

N70-25179# Akademiya Nauk URSR, Kiev.
LINEARIZATION OF THE OUTPUT VALUE OF MAGNETIC INDUCTION METERS BASED ON THE HALL EFFECT
V. B. Savitskiy, N. N. Sytnikov, and N. Ye. Fevraleva *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 133–140 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The defect of such meters is the nonlinearity of the scale of the output device when measuring induction above 1 mm. Decreasing the nonlinearity of the output value caused by the induction of the magnetic field can be accomplished by the following methods: 1) by the selection of the geometric dimensions of the sensing device; 2) by using an additional magnetic resistance meter; 3) by using a semiconductor plate as the Hall generator and the resistance; 4) by using a circuit which ensures piece-linear approximation. A comparative analysis is presented for these methods. Practical linearization circuits are shown. Transl. by H.W.

N70-25180# Akademiya Nauk URSR, Kiev.
ANALYSIS OF COMPARATOR ERRORS CAUSED BY THE NON-SQUARENESS OF CONVERTER CHARACTERISTICS
Yu. M. Panchishin *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 141–146 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The absolute error in determining the measured value is estimated, when the converter characteristics differ from the square-law and the effective value of the variable is taken to be equal to a constant value. The effect of higher harmonics of the voltage components is determined. Analysis of the errors caused by the nonsquareness of the converter characteristics permits estimation of the effect of the degree of deviation of comparator converter characteristics of the effective value from the square-law characteristics, which is very important in devices designed for the precise determination of measured values. Transl. by H.W.

N70-25181# Akademiya Nauk URSR, Kiev.
SIMPLIFIED DESIGN FOR SWITCHING TOROIDAL MAGNETIC ELEMENTS WITH RECTANGULAR HYSTERESIS LOOPS
B. Ye. Kostrzhevskiy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 147–151 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A method is studied for simplifying the design of the elements by linearizing the nonlinear dynamic characteristics of the core. The switching parameters are determined experimentally by switching the cores at a specific rate. The method considered may be used for the more complicated cases of connecting a load with a diode bypass or for the case of switching by using the input of a semiconductor triode as the load. Transl. by H.W.

N70-28200*# Martin Marietta Corp., Orlando, Fla.
FLUIDIC PLASMA DISPLAY STUDY, PHASE 3 Quarterly Report
Jacq van der Heyden Jul. 1969 22 p
(Contract NAS12-532)
(NASA-CR-86338; OR-10174; QR-1) Avail: CFSTI CSCL 09E

Efforts were concentrated mainly on building experimental hardware and test setups, and conducting experiments on gas cell matrices and fluidic control circuits. Background material on plasma display systems, fluidic control systems, and fluidic plasma display systems is included. Crosstalk problems on fluidic line and column control are investigated. Cross grid control is described, and oscillatory cross grid control is mentioned. Experimental hardware was designed; specifically, simulated display matrix, plasma cell display matrix simulator, neon manifold and test panel, experimental plasma cell matrix, and experimental fluidic control systems. N.E.N.

N70-25201*# Martin Marietta Corp., Orlando, Fla.
FLUIDIC PLASMA DISPLAY STUDY, PHASE 3 Quarterly Report, 5 Jul. - 5 Oct. 1969
Jacq Van Der Heyden Oct. 1969 33 p
(Contract NAS12-532)
(NASA-CR-86339; OR-10320; QR-2) Avail: CFSTI CSCL 09E

Construction of experimental hardware and experiments with gas cell matrices and fluidic control circuits were continued. Emphasis was on improving the oscillatory cross grid control and column control. The experimental plasma cell matrix was redesigned, construction was begun on the fluidic control system, and a survey of pumps for power supply was made. Background material on plasma display systems, fluidic control systems, and fluidic plasma display systems is included. N.E.N.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-23925*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A SERIES CAPACITOR INVERTER-CONVERTER FOR MULTIKILOWATT POWER CONVERSION
Francise C. Schwarz Washington Apr. 1970 37 p refs
(NASA-TR-R-336; C-103) Avail: CFSTI CSCL 09C

A nonlinear, active network that transforms the voltage waveform of a unipolar source of energy is presented. This network consists of ideally lossless elements such as inductors, capacitors, and on-off switches. Control is obtained by variation of the mode of switch operation. A circuit philosophy is applied which is adapted to the characteristics of switch operation and confines the stresses imposed on circuit components to moderate levels. Results of experimental work are reported and include: (1) test data of a 95% efficient, 2-kW dc transformer having a power density of 0.4 kW/kg; and (2) integration of this transformer with an ion propulsion engine. Author

N70-24010*# Arizona Univ., Tucson. Electrical Engineering Department.
RESEARCH IN AND APPLICATION OF STATE VARIABLE FEEDBACK DESIGN OF GUIDANCE CONTROL SYSTEMS FOR AEROSPACE VEHICLES Progress Report
T. L. Williams, R. T. Stefani, and S. Yakowitz Mar. 1970 50 p refs
(Grant NGR-03-002-115)
(NASA-CR-109451) Avail: CFSTI CSCL 09C

Studies on weighted least squares parameter estimation, Kalman filter problem, and random search are presented. In the first paper, techniques for the estimation where all sensor measurements are noisy are discussed. The problem is to provide an unbiased estimate of the matrix relating the exact states in a manner that is optimal in a least squares sense. The weighting matrix is derived to minimize the variance of error, and examples of selecting the weighting matrix are given. A simulation of the parameter estimator is included. The case for which the measurement noise for a Kalman filter approaches zero is also discussed. It is shown that the result is a filter suggested by conventional state variable feedback and estimation techniques. Research on random methods for seeking maxima, optimum sequential search and approximation, minimization techniques, nonlinear and dynamic programming, and related topics are reviewed. N.E.N.

N70-24062*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.
DEVELOPMENT OF TECHNIQUES FOR THE CONSTRUCTION OF SEMICONDUCTOR NETWORKS AND DEVICES
William E. Owen 1967 238 p refs *Its* Engr. Res. Bull. No. 92
(Contract NAS8-11227)
(NASA-CR-102592) Avail: CFSTI CSCL 09E

Techniques are investigated for construction of diffused semiconductor networks and devices and procedures are developed for implementing these techniques, with particular attention to the use of simple and inexpensive equipment. Studies of the various operations required for construction of the networks and devices were made from the standpoint of obtaining a thorough understanding of the factors entering into each of the operations. The physical steps are described in sufficient detail to permit personnel not familiar with the operations to duplicate the performance described. The basic theory involved in each of the operations is presented and the results are illustrated photographically. Poor, as well as good, results are presented and the reasons for obtaining unsatisfactory operations are described. Author

N70-24097*# Harry Diamond Labs., Washington, D.C.
SIMPLIFIED ANALOG/HYBRID SOLUTIONS TO ALGEBRAIC EQUATIONS AND BOUNDARY-VALUE PROBLEMS
Arthur Hausner Sep. 1969 38 p refs
(AD-699345; HDL-TR-1461) Avail: CFSTI CSCL 12/1

An experimental method is outlined for achieving the simplest possible stable feedback connections in a direct nulling solution of algebraic equations on an analog computer. A proof of stability for linear equations, sufficient conditions of constructability for nonlinear equations, and examples for both situations are given. In essence, the method requires a sensitivity test near the root, with the computer nulling previously connected residual errors. Once the feedback structure is obtained, the circuit automatically tracks solutions for wide variations of parameters. The technique is extended to analog/hybrid solutions of boundary-value problems, where feedback connections to accumulator circuits are determined experimentally. A five-parameter optimal control problem is solved automatically by this method. Author (TAB)

N70-24166*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REALIZATION OF A COMPUTER MEDIUM USING ELEMENTS WITH COMBINED FUNCTIONS
A. I. Mishin 13 Aug. 1969 16 p refs Transl. into ENGLISH from Akad. Nauk SSSR Sibirskoy Otd., Inst. Mat. Vychislitelnyye Sistemy (USSR), no. 26, 1967 p 83-95
(AD-699234; FTD-HT-23-31-69) Avail: CFSTI CSCL 9/2

Realization of a computing medium, i.e., an aggregate of self-adaptive and highly homogeneous computer circuits, is investigated by considering that each cell of the medium consists of an address circuit, a memory, and a function circuit. As in real circuits the first two components usually require 90 percent of the circuit elements, all three are considered together in defining a function expressing the number of circuit elements which is subsequently minimized. Circuit variants in which each of three sections on the average performs 1.6-2.5 logic functions are studied. As a starting point, a study is made of a gated inverter circuit which either inverts the input signal or gives a constant output. More complex and at the same time versatile circuits resembling the generic inverter are presented which use transistors, diodes, and unipolar transistors. In addition all of these variants include elements whose I-V characteristic has an S-shape. TAB

N70-24286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS AND DESIGN OF DIRECT-COUPLED COMPUTER CIRCUIT ELEMENTS EMPLOYING MOS TRANSISTORS
A. N. Karmazinskii et al 20 Aug. 1969 29 p refs Transl. into ENGLISH from Mikroelektron. SB. Statey (USSR), no. 1, 1967 p 203-238
(AD-699235; FTD-HT-23-292-69) Avail: CFSTI CSCL 9/2

An analysis is made of a circuit operating with direct connections using MOS transistors. Methods of designing single elements are discussed. Matching conditions of such circuits and the criterion of nondistortion transmission of given signal levels in logic circuits are also considered. It was found that if MOS transistors are used with induced channels the direct matching of logic circuits can be accomplished only by using the the sauce type of transistors. Analyses are made of the static characteristics and transient processes in a key circuit, and of the static condition of the trigger. The switching characteristics of NOT-OR and NOT-AND logic circuits are given. The design of these circuits is reduced to the design of a key circuit with one transistor. TAB

N70-24382 Mississippi State Univ., State College.
TOPICS ON THE OPTIMAL CONTROL OF LINEAR SYSTEMS WITH INACCESSIBLE STATE VARIABLES
Virgil Lee Dugan (Ph.D. Thesis) 1969 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-19815

This dissertation is concerned with the design of optimal, linear, time invariant, regulator systems which have inaccessible states and which are based on a quadratic performance functional for the definition of optimality. Two theorems which define the non-zero, constant elements of suboptimal feedback vector and a set of dimensional linear manifolds for which the response of an infinite-terminal-time regulator system will be exactly optimal or will provide an extremal of the performance functional are developed and proved. In parallel with the development of these theorems a method for determining the optimal control and the corresponding cost without the necessity of solving any non-linear algebraic equations is presented. All of these techniques rely upon the determination of the eigenvalues of the matrix associated with an optimal boundary value problem. Dissert. Abstr.

N70-24407 Polytechnic Inst. of Brooklyn, N.Y.
THRESHOLD ANALYSIS OF PHASE LOCKED LOOPS
Paul Wray Osborne (Ph.D. Thesis) 1969 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-20355

A method for estimating the expected number of spikes in phase locked loops is presented. Unlike previous analyses, the technique developed here can be applied to phase locked loops of any order, with or without modulation. The modulation must be deterministic, though a random modulating signal can, in principle, be employed if it is approximated by a deterministic quasi-random signal. The Frequency Modulator with Feedback (FMFB) can also be analysed by the method. To perform the required spike estimation, it is assumed that the noise is a deterministic function, which is defined as most-likely noise. The real noise driving the phase locked loop is derived from an IF filter driven by white noise. Dissert. Abstr.

N70-24418 Montana State Univ., Missoula.
AN ENGINEERING ANALYSIS OF SYSTEMS CONTAINING TIME-VARYING ELEMENTS
Philip Alan Buckley (Ph.D. Thesis) 1969 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-20125

A general method of analysis is developed for single input, single output, linear, time-varying systems by use of familiar Laplace transform techniques. Electrical networks containing sinusoidally varying capacitors and excited by sinusoidal sources are investigated. Two sufficient conditions for the absolute and uniform convergence of the series solutions are developed, one valid for the solution after steady state conditions have been reached, the other valid for the total time solution including transient response. The method of analysis is applied to the general case of equations with time-varying coefficients and the method is extended to include nonsinusoidal yet periodic variation of system parameters, more than one time-varying element in the system, systems in which all the elements are time-varying, arbitrary time variations of system parameters, and time-varying systems excited by modulated signals. Dissert. Abstr.

N70-24483 Minnesota Univ., Minneapolis.
SYNTHESIS OF FEEDBACK CONTROLLERS FOR SYSTEMS WITH TIME-DELAY
Yogish Alekal (Ph.D. Thesis) 1969 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-19996

This investigation develops techniques for synthesizing feedback controllers for systems described by differential difference equations. The study begins with a linear system whose state is not completely available for measurement. A feedback controller is synthesized for such a system which depends on the past history of the available output. The stability of the resulting differential difference equation is analyzed. Then a system with time-delay in its dynamics is considered and the problem of stabilizing the system by means of a feedback controller is discussed. The problem of synthesizing an optimal feedback controller which minimizes the quadratic cost functional is solved and an optimal feedback control law is obtained. The question of existence of feedback control law is obtained. The question of existence of feedback coefficients and a computational algorithm are also studied. The computation procedure is illustrated by means of an example. Dissert. Abstr.

N70-24498# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NEIGHBORING OPTIMAL METHOD FOR THE SOLUTION OF OPTIMAL CONTROL PROBLEMS
Austin L. Foote, Roger W. Johnson, and Donald Norris Dec. 1969 33 p refs
(AD-699204; AFIT-TR-69-10) Avail: CFSTI CSCL 12/1

The solution to a general class of optimal control problems is derived using the neighboring optimal method. The problem is first transformed using the minimum principle of Pontryagin into a two-point boundary value problem. The solution to the boundary value problem is formulated as minimizing a terminal error function. Sensitivity coefficients are derived to provide a means, in conjunction with a linear search, of sequentually approaching the solution. The sensitivity coefficients are also used to derive a feedback control law. The neighboring optimal method can be used in fixed time problems, and problems with either free or fixed terminal state conditions. Author (TAB)

N70-24507 Pennsylvania Univ., Philadelphia.
SUBOPTIMAL CONTROL OF LINEAR TIME-INVARIANT MULTIVARIABLE SYSTEMS SUBJECT TO CONTROL STRUCTURE CONSTRAINTS
Robert Leonard Kosut (Ph.D. Thesis) 1969 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-21381

A method is presented for the design of controllers for linear, time-invariant systems whose states are not all available or accessible for measurement and where the structure of the controller is constrained to be a linear, time-invariant combination of the measurable states of the system. Two types of structure constraints are considered: (1) Each control channel is constrained to be a

linear, time-invariant combination of one set of measurable states; (2) each control channel is constrained to be a linear, time-invariant combination of different sets of measurable states. The control system, subject to the above constraints, is selected such that the resulting closed-loop system performs as near to some known optimal system as is possible, i.e., suboptimal. The nearness of the optimal system to the suboptimal system is defined in two ways and thus two types of suboptimal controllers are found. Dissert. Abstr.

N70-24621 Stevens Inst. of Tech., Hoboken, N.J.
AN ALGORITHM FOR A SOLUTION TO IDENTIFICATION
Bipin D. Parikh (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-21300

The fast converging property of these generalized Fourier series creates ill-conditioning of the system equation. This research presents a technique to improve the condition of these equations. It is shown here that when the rotational transformation, necessary to diagonalize the input coefficient correlation matrix, is used to rotate the basis axes for the system expansion, then condition of the system equations is improved. The effect of measurement noise in the input series coefficients, towards the solution of the impulse response coefficient is also reduced by obtaining rotational matrix from the correlation matrix which is statistical in characteristics. It has been shown here that as a first degree of approximation the rate of the change of the output correlation is inversely proportional to the system impulse response coefficients. A factor index defined as a function of the output correlation is used to characterize a system or to monitor the changes in system characteristics in an adaptive control system. A complete algorithm for identification of system characteristics using normal operating records only is described. Dissert. Abstr.

N70-24625 Minnesota Univ., Minneapolis.
OPTIMAL CONTROL OF LINEAR SYSTEMS WITH RANDOM PARAMETER
Holavanahally Vasudevachar Gururaja (Ph.D. Thesis) 1969 229 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-20017

The problem of optimal controls with random (or unknown) parameter(s) is studied in the case of linear time varying systems. It is assumed that the probability distribution function of the random parameter is known. The problem of choosing an optimal controller which minimizes the expected value of an integral quadratic performance index is considered. Two types of controllers viz., 1) open loop controller and 2) closed loop controller can be thought of for the optimal controllers. Necessary conditions that the optimal controller has to satisfy are derived for both types of controllers. In the case of open loop controller the necessary condition is also shown to be sufficient. In the case of closed loop optimal controller the sufficiency conditions are hard to obtain. The theory developed is applied to the pitch axis control problem of an aircraft. Also, numerical examples are included to illustrate the theory at each stage. Dissert. Abstr.

N70-24609 Washington Univ., Seattle.
STABILITY OF A CLASS OF PULSED-FREQUENCY MODULATED CONTROL SYSTEMS
George Elbert Shortle, Jr. (Ph.D. Thesis) 1969 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-20273

A new class of pulse frequency modulated control systems, called discrete sigma is presented. The investigation of the stability properties of discrete sigma systems is presented with the application of a new stability criterion derived from Tsypkin's extension of the Popov stability criterion. A new frequency domain stability criterion employing a Popov-type multiplier is obtained for a class of nonlinear PAM control systems containing a monotonically non-decreasing nonlinearity. The memoryless nonlinearity of a descrete sigma system is included in this class. Unlike other criteria of this type, no upper bound is placed on the derivative of the nonlinearity. A number of examples are given to illustrate that the criterion will in general give less conservative conditions for stability of descrete sigma systems than any previous criteria. Two of the examples are shown to be counterexamples to Aizerman's conjecture for PAM systems. Dissert. Abstr.

N70-24637*# Arizona Univ., Tucson. Engineering Experiment Station.
CONTROL SYSTEM DESIGN USING OPTIMIZATION TECHNIQUES Final Report
R. T. Stefani, J. H. Dial, T. L. Williams, and D. E. Silverstone Aug. 1969 104 p refs
(Grant NGR-03-002-115)
(NASA-CR-109405) Avail: CFSTI CSCL 09C

Application of optimization techniques to the control of the fuel valve system for an air-breathing jet engine and specification of the poles of the feed-back compensator are discussed. The sequential unconstrained minimization technique incorporates the inequality constraints into the objective function. The final result is a design which has a small low frequency sensitivity, realizes the desired closed-loop transfer function, and results in stable compensator transfer functions. A different optimization procedure, the method of parallel tangents, constructs a vector search in a direction which is orthogonal to all the previous searches. The last two optimization procedures are applied to the 40-60 inlet control problem which entails minimizing the response of the shock wave in the inlet to pressure disturbances from the compressor side of the inlet. The first procedure utilizes a pattern search to optimize the feedback compensator between the exit pressure and the bypass doors. The variable metric optimization procedure determines the best control system for the inlet, and assumes that the objective function is nearly quadratic and determines the optimum in one less step than the number of parameters if the objective function is quadratic. Author

N70-24752 Pennsylvania Univ., Philadelphia.
THE APPLICATION AND DEVELOPMENT OF SEARCH TECHNIQUES FOR FAULT ISOLATION
William Graham Faust (Ph.D. Thesis) 1969 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-21347

Approaches for extending the ability to automatically determine the cause of malfunctioning networks which process time varying signals are investigated. Measurements made at a limited number of test points are regarded as non-linear functions of the parameters used to model the components in the network. Although the exact nature of these non-linear equations is never determined since they are in numerical form, multi-dimensional search techniques may nevertheless be used for their solution. The selection of the Gauss curve fitting technique as the search technique demonstrated the best properties for piece-part fault isolation. Two new procedures are then developed to act as preprocessing data filters for the Gauss curve fitting technique. Together the techniques frequently serve to eliminate entirely the use of the Gauss curve fitting technique. Dissert. Abstr.

N70-24784*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DUAL-RATE FINITE-SETTLING-TIME DISCRETE SYSTEMS
J. A. Gatlin Washington Apr. 1970 22 p refs
(NASA-TN-D-5745; G-973) Avail: CFSTI CSCL 09C

Finite settling time response for single input/single output feedback control systems can be obtained using the presented dual-rate, sampled-data control algorithm. The control level is updated every T seconds by the algorithm, which serially accumulates N weighted, plant output error samples during each T second interval.

Memory of the previous control level is used to reduce the noise factor of the discrete algorithm. Design examples using amplitude and pulse-width modulation illustrate the design technique. Results of a hybrid computer simulation of the amplitude modulation design present the characteristic transient and steady-state performance obtained. Author

N70-24788 State Univ. of New York at Buffalo.
THE NOISE SENSITIVITY OF OPTIMAL CONTROL SYSTEMS AND THE DESIGN OF SUBOPTIMAL CONTROL LAWS
Clyde Adams Miller (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-20574

Optimal control systems are not always stable control systems from the standpoint of noise-like perturbations of the state or costate vectors. Sufficient conditions are developed for system stability employing nothing more than the continuity and differentiability of pertinent system functions and the continuity and differentiability of the control law, u(X,p,t). Once the stability of the system is ensured, the sensitivity of the system to disturbances in the state and costate vectors is bounded using Lipschitz conditions. The synthesis of insensitive suboptimal systems is then readily accomplished in the linear case and can be accomplished with some effort in the nonlinear case. It is demonstrated that insensitive suboptimal systems do not necessarily imply systems that perform poorly. Insensitive control systems have the advantages that the initial costate vector may usually be found using an approximation-to-the-problem technique and that approximate methods may be used for the on-line generation of initial costate vectors. Dissert. Abstr.

N70-24842# Washington Univ., St. Louis, Mo. School of Engineering and Applied Science.
STOCHASTIC OPTIMAL CONTROL WITH IMPERFECTLY KNOWN PLANT DISTURBANCES
Tzyh Jong Tarn 15 Oct. 1969 11 p refs Revised
(Grant AF-AFOSR-1422A-68)
(AD-698861; CSSE-692; AFOSR-69-3070TR) Avail: CFSTI CSCL 12/1

It is the purpose of this correspondence to show how filtering theory based on a Bayesian approach may be used to solve the problem of optimally controlling a linear discrete stochastic system in which the additive Gaussian plant noise has fixed but unknown variance. Selecting a reproducible type of probability density and applying dynamic programming, an exact analytical solution of the feedback control law may be found. Author (TAB)

N70-24907# Los Alamos Scientific Lab., N.Mex.
ANALYSIS OF THE SPURIOUS FREQUENCY RESPONSE OF MIXERS
William E. Wageman Sep. 1969 10 p refs
(Contract W-7405-eng-36)
(LA-4296) Avail: CFSTI

The spurious frequency response of mixers is discussed and the use of a desk-top electronic calculator to find these spurious frequencies is illustrated. Programs are given to calculate the frequencies at which the designer can expect to find trouble with a specified set of input and output frequencies. Both sharply tuned and broadband output mixers are considered. Author (NSA)

N70-24929 Montana State Univ., Missoula.
FAULT LOCATION IN CELLULAR ARRAYS
Kenneth James Thurber (Ph.D. Thesis) 1969 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20127

The development of concepts and techniques to be used in the testing of cellular logic arrays is proposed. In particular, the subject is to develop techniques to locate, detect, and isolate failures in cellular logic arrays. The most general fault location theory is sought for two dimensional cellular arrays consisting of two-input, one-output cells. The theory presented utilizes a physical basis to assume a maximum set of allowable errors and thus realistically accounts for the appearance of cell failures. Dissert. Abstr.

N70-24949 Polytechnic Inst. of Brooklyn, N.Y.
OPTIMAL STOCHASTIC CONTROL OF CONTINUOUS SYSTEM WITH NOISY MEASUREMENTS
Richard Gran (Ph.D. Thesis) 1969 55 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-20337

The problem considered is that controlling a continuous stochastic linear system where measurements are made through a noisy channel. The performance index which is minimized permits controls which are non-linear and bounded and the terminal time for the control action is allowed to be a random stopping time which is a functional of the measurement process. The solution to this problem uses the shochastic maximum principle which was developed by Flemming to show that the optimal control is a function of the optimal (Kalman) estimate of the system state. Conditions necessary for the optimal control to be the result of cascading the noise free optimal control with the optimal estimate are derived. Several examples are included to illustrate the theory. Dissert. Abstr.

N70-24979# Technische Hogeschool, Eindhoven (Netherlands).
SOME IDENTIFICATION SCHEMES FOR NON-LINEAR NOISY PROCESSES
J. Z. Westenberg (M.S. Thesis) Dec. 1969 22 p refs
(TH-69-E-09) Avail: CFSTI

A general mathematical description for non-linear systems in the time-domain is elaborated in this paper. Four algorithms for estimating the parameters of time-discrete processes corrputed by additive noise are studied and instrumented on a digital computer. All identification schemes may be employed in on-line applications. The properties of each algorithm are given; numerical results and amount of complexity are compared. Author

N70-25007 Polytechnic Inst. of Brooklyn, N.Y.
STABILITY OF RANDOMLY SAMPLED SYSTEMS
Leonard Tobias (Ph.D. Thesis) 1969 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-20379

Randomly sampled control systems are studied by a stochastic Lyapunov function method. The control loops under consideration consist of a random sampler (a sampling device which closes at a set of statistically described times in lieu of periodic intervals), a zero order hold, a linear plant and feedback elements. Sampled systems are modeled randomly when sampler imperfections such as jitter or skipping occur or when a single computer or communications link is a component of multiple control loops. This type of model has also been suggested for a human operator performing a compensatory tracking function. Improved stability criteria are given for systems whose inputs are identically zero for all time. When the feedback element is linear, sufficient conditions for asymptotic mean square stability and symptotic stability with probability one are obtained and compared. When random inputs are present, a general method is given for the computation of the asymptotic mean square output at sample instants. Dissert. Abstr.

N70-25117 California Univ., Berkeley.
COMBINATORIAL METHODS FOR MULTICOMMODITY FLOW PROBLEMS
Bill Rothfarb (Ph.D. Thesis) 1968 90 p

Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-3688

A method is presented for finding the maximum total flow for a class of 3-commodity networks. For n-commodity networks with distinct sources and a common terminal, an algorithm is derived for finding feasible flow patterns. Dissert. Abstr.

N70-25140# Eidgenossische Technische Hochschule, Zurich (Switzerland).

DESIGN AND EVALUATION OF A METHOD FOR ADAPTIVE CONTROL OF AUTOMATIC CONTROL LOOP WITH SIMULTANEOUS HARMONIC TEST SIGNALS [ENTWURF AND ERPROBUNG EINES VERFAHRENS ZUR GEREGELTEN ADAPTIERUNG EINES REGELKREISES MIT SIMULTANEN HARMONISCHEN PRUEFSIGNALEN]

Adolf Hermann Glattfelder (Ph.D. Thesis) 1969 188 p refs In GERMAN *Its* Diss. No. 4275

Avail: CFSTI

The general idea was to find an adaptation method starting from definitions and methods of linear control theory which are familiar to the control engineer in industry and thus contribute to the closing of the gap between control theory and industrial applications. The following assumptions are made concerning the system to be adapted and the necessary apparatus. The chosen system consists of a one-loop feedback. Its plant must be linearizable around all values of the state variables as in linear control theory and its order must be higher than three. The controler network has to be linear too and should be of P-, PI- or PID-type. It was also found that only a few properly selected points of the transfer function are needed for the adaptation. These points are to be found at the maxima of the sensitivities in regard to the controller settings, in case of using the phase shift only. Assuming this the aim of adaptation also proved to be quite simple: The phase representation in the Bode plot must be as straight as possible with an inclination of 100 to 110 deg per octave. Then the step response has a minimum length with sufficient damping (the third maximum just vanishes) and gives approximately the same result as the ITAE-performance index. Finally the stability characteristics of the whole system were analyzed in a simple model separating process and adaptor feedback loops completely. The stability domain for instance was found to be approximately 1 : 3 wide expressed by the variation of the dominant frequency of the closed loop after adaptation in the special case of stationary test frequencies. Author

N70-25147 Pennsylvania Univ., Philadelphia.

OPTIMUM STOCHASTIC AND DETERMINISTIC CONTROL SYSTEM SYNTHESIS USING QUADRATIC PROGRAMMING

Jay Edward Marowitz (Ph.D. Thesis) 1969 170 p

Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-21403

Quadratic programming is applied to the stochastic and deterministic design of continuous linear systems. The system design procedure is based on the constrained minimization of quadratic performance indices such as mean square error and integral square error. The developed constraints control the stability, realizability, or the deterministic behavior of the systems designed. The performance indices measure either the stochastic or deterministic system behavior not represented by the constraints. Application of the basic design technique to the statistical design of dynamically-exact velocity-inertial navigation systems is also presented. Dissert. Abstr.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-23927# Federal Aviation Administration, Washington, D.C. Dept. of Transportation.

TWENTY-FOURTH ANNUAL REPORT OF OPERATIONS UNDER THE FEDERAL AIRPORT ACT

1969 65 p

(AD-699497) Avail: CFSTI CSCL 1/5

Contents: Organization for carrying out the act; Airport planning; Airport development; Protection of the public interest in airports; and Airport design, construction, and safety standards. TAB

N70-24007*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CRATER DEFLECTION STUDIES

Ritchie B. Coryell and Larry Durr 20 Mar. 1970 33 p refs

(Contract NAS7-100)

(NASA-CR-109460; JPL-760-44) Avail: CFSTI CSCL 13F

The purpose of the experiments reported in this document was to gain a first-order understanding of the deflection of which a vehicle, with wheels locked in a dead-ahead position as it traversed a crater, would be subjected. These experiments involved a statistical test using a model vehicle that traversed craters constructed in sand. No attempt was made either to scale the vehicle to experimental size or to simulate the lunar environment. Rather, the objective was an inexpensive, large statistical sample of the crater deflection of a model vehicle. Results from these stochastic experiments provide hints as to some properties of such a model and data for calculation of some limited performance characteristics of a wheeled vehicle on the cratered surface of the moon. This document reports the experimental apparatus and procedures, a statistical summary of the experimental data, and salient features of the results. Author

N70-24011# Los Alamos Scientific Lab., N. Mex.

MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending 31 Oct. 1969

1 Dec. 1969 48 p refs

(Contract W-7405-eng-36)

(LA-4310) Avail: CFSTI

Operation of the Electron Prototype Accelerator is described and the development of the Los Alamos Meson Physics Facility is outlined. Linac structures, rf power systems, accelerator control and instrumentation, accelerator physics, the experimental area, the LAMPF users, LAMPF scheduling and facility construction, and physics research are discussed. NSA

N70-24041# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

PISTON DRIVEN SHOCK TUBE AT KYOTO UNIVERSITY

G. Kamimotot, T. Akamatsu, K. Teshima, H. Matsui, H. Shirai et al Dec. 1968 14 p refs

(CP-23) Avail: CFSTI

A description of a piston driven shock tube and some results of its performance tests is given. The compression processes are studied experimentally and compared with a theoretical prediction. The shock speed and the flow duration time are measured by electrostatic probes. Author

N70-24042# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

NEW HYPERSONIC GUN TUNNEL AT KYOTO UNIVERSITY

G. Kamimoto, T. Kimura, H. Matsui, Y. Uenaka, and A. Tsukamoto Dec. 1968 25 p refs
(CP-22) Avail: CFSTI

Theoretical and experimental performances of a gun tunnel NAS obtained. By these data, a large-sized hypersonic gun tunnel was built on March in 1967. Its mechanisms and performances are discussed. Author

N70-24090# California Univ., Santa Cruz.
SYSTEM FOR THE STUDY OF THE SURFACE IMPEDANCE OF TYPE 2 SUPERCONDUCTORS IN STRONG RF FIELDS
Bruce Rosenblum 1969 10 p
(Contract N00014-68-A-0381-001)
(AD-698482; TR-1) Avail: CFSTI CSCL 14/2

The report describes test facilities developed for the study of the surface impedance of type 2 superconductors in strong high frequency rf fields. TAB

N70-24111# Aberdeen Proving Ground, Md. Ballistic Research Labs.
COMPRESSOR AIR SEAL FAILURE, SUPERSONIC WIND TUNNELS, ABERDEEN PROVING GROUND, MARYLAND, 20 MAY 1969
Ernest P. Reklis Oct. 1969 28 p refs
(AD-699315; BRL-TN-1724) Avail: CFSTI CSCL 14/2

On 20 May 1969 in Compressor Plant No. 1 of the Supersonic Wind Tunnels, Exterior Ballistics Laboratory, a stoppage of air flow through the labyrinth seals of the centrifugal air compressors caused about 20 gallons of lubricating oil to be drawn into the compressors and main air piping system used in the operation of the supersonic wind tunnels. Air seal operation, the oil problem and clean-up are discussed. Author (TAB)

N70-24117# Maryland Univ., College Park.
ACCELERATION OF SUPER-HEAVY IONS AT THE MARYLAND CYCLOTRON: FEASIBILITY STUDY
V. E. Viola, Jr., G. E. Gordon, M. P. Reiser, and R. Woody Sep. 1969 60 p refs
(Contracts AT(40-1)-3783; AT(40-1)-3491)
(MNC-3783-4) Avail: CFSTI

As a result of the great current interest in the production of very heavy elements, the feasibility of constructing a super-heavy-ion accelerator at the University of Maryland has been investigated. It is concluded that by taking advantage of the unique features of the existing isochronous cyclotron, such an accelerator could be realized at Maryland at a low relative cost and in a minimum of time. As an alternative long-range approach, the possibility of achieving intense beams of the desired heavy ions by means of electron ring acceleration is discussed. The breadth of research made possible with such a facility is reviewed, giving special emphasis to the problems involved in heavy element synthesis. Finally, the capabilities for development of a super-heavy ion accelerator at Maryland are summarized. Author (NSA)

N70-24124# Stanford Linear Accelerator Center, Calif.
THE 40-INCH HYDROGEN BUBBLE CHAMBER CONVERSION TO 70 KILOGAUSS SUPERCONDUCTING MAGNET, PROPOSAL 3
John Alcorn, Joseph Ballam, Richard Blumberg, Habibo Brechna, Henning Petersen et al Sep. 1969 120 p refs
(Contract AT(04-3)-515)
(SLAC-108) Avail: CFSTI

Extensive design modifications for the SLAC- 40-inch bubble chamber magnet to provide it with a 70 kG magnetic field and an improved optical system are proposed. Design of the superconducting magnet system is described, and modifications for the vacuum tank, coil dewar assembly and supports, refrigeration system, chamber body, optical system, and expansion system are described. A time schedule and cost estimate are presented. NSA

N70-24194# Naval Civil Engineering Lab., Port Hueneme, Calif.
SKIWAY FOR C-130 AIRCRAFT AT PALMER STATION, ANTARCTICA Interim Technical Note, Jan. - Oct. 1969
Russell A. Paige Dec. 1969 21 p
(AD-699165; NCEL-TN-1067) Avail: CFSTI CSCL 1/5

Palmer Station, Antarctica, which is located on Anvers Island west of the Antarctic Peninsula, has been supported entirely by ice breakers and cargo ships during the austral summer; a capability for air support would extend this season, improve the movement of essential cargo and personnel, and provide for emergency support. This technical note presents the feasibility of establishing a skiway for ski-equipped C-130 aircraft on the Marr Ice Piedmont about three miles from the station. It also describes the reconnaissance techniques used in February 1969 to locate the skiway site and safe access route through the marginal crevasse zone between this site and Palmer Station for one-ton capacity tracked carriers. Author (TAB)

N70-24252# Joint Publications Research Service, Washington, D.C.
VISIT TO THE SPACE COORDINATION-COMPUTATION CENTER
Andrey Yermolin 2 Mar. 1970 7 p Transl. into ENGLISH from Ogonek (Moscow), no. 43, Oct. 1969 p 25-26
(JPRS-49951) Avail: CFSTI

A journalistic report of the activities in the space communication computer center is given. The operations mentioned include voice communication with the spacecraft, orbit correction, transfer to descent trajectory, breaking, parachute deployment, and landing. N.E.N.

N70-24390# European Space Operations Center, Darmstadt (West Germany).
SIMULATION OF SPACECRAFT OPERATIONS
P. B. Lemke Aug. 1969 15 p
(ESRO-TM-144-(ESOC)) Avail: CFSTI

The purpose and importance of simulations at control centers and ground stations before a spacecraft is put into orbit are outlined. Simulations are based on a data source, and magnetic tape, and attention is drawn to the importance of selecting the most suitable data. Author (ESRO)

N70-24411# European Space Research and Technology Center, Noordwijk (Netherlands)
THE ESRO IONOSPHERIC SOUNDING STATION AT CAPO SAN LORENZO, SARDINIA [LA STATION DE SONDAGE IONOSPHERIQUE DU CERS A CAPO SAN LORENZO, SARDAIGNE]
G. E. N. Scoon Aug. 1968 37 p In FRENCH; ENGLISH summary
(ESRO-TN-32F(ESTEC)) Avail: CFSTI

Operational characteristics and capabilities of the ESRO Ionospheric Sounding Station, situated at Capo San Lorenzo on the Italian Sounding Rocket Range. A brief account is given of the agreement under which ESRO was allowed to install and operate this station. A description is given of the station, including specifications of the equipment and antenna systems and its principles of operation. The capabilities of the ionosonde system are indicated. A note on the utilization of the station, with illustrations of typical ionograms, is attached as an appendix. Author (ESRO)

N70-24444 Washington Univ., Seattle.
REGIONAL AIRPORT PLANNING: A SYSTEMATIC MODEL
Richard Duane Shinn (Ph.D. Thesis) 1969 327 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 69-20272

The history of airport planning and development, participation by various organizations and issues and alternate futures are examined in each of four cases: (1) Southern California, (2) San

Francisco Bay Area, (3) Puget Sound Region, and (4) Portland (Oregon) Metropolitan Area. Interviews, evaluation of documented efforts and Scenario writing are used to establish issues with relevance in the 1990 time-frame. These issues are synthesized and used to orient a matching of participants' normal actions with analytical tasks in a systematic model. Joint agreements between operating agencies are seen as an evolutionary means of transferring facilities and resolving jurisdictional questions. Similarly, joint agreements for study of regional aviation issues and planning for a regional airport system are considered ample to assure continuity of regional airport planning. Dissert. Abstr.

N70-24584# Los Alamos Scientific Lab., N.Mex.
MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Period Ending 30 Apr. 1969
29 May 1969 40 p refs
(Contract W-7405-eng-36)
(LA-4184) Avail: CFSTI

Recent developments at LAMPF are discussed including developments in accelerator structures, RF power systems, accelerator control and instrumentation, accelerator physics, and the experimental area. NSA

N70-24618# Atomics International, Canoga Park, Calif.
SODIUM CHEMISTRY LOOP FACILITY DESCRIPTION
J. Guon and H. A. Vislay 30 Jun. 1969 52 p refs
(Contract AT(04-3)-701)
(AI-AEC-12833)

An experimental facility, the Sodium Chemistry Loop (SCL), was constructed to study the equilibrium between sodium oxide and metal oxides in sodium systems. Operational data indicate the SCL meets or exceeds specifications. Although new data on the oxygen probe have been developed, the probe's performance is not yet understood well enough to evaluate its effectiveness in developing kinetic data for the sodium–oxygen–metal systems to be studied. Author (NSA)

N70-24657# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
UTILITIES ON PERMANENT SNOWFIELDS
Malcolm Mellor Oct. 1969 44 p refs
(AD-699337; CRREL-CRSE-3-A2D) Avail: CFSTI CSCL 13/13

The topics covered in the monograph include water supply, waste disposal, heating, ventilating and fire protection at installations built on polar ice sheets. The section on water supply discusses energy requirements, consumption rates, water quality and treatment, techniques and equipment for melting snow and ice, and water distribution systems. A number of actual water supply systems are described in detail. The section on waste disposal deals with sewage and sewage sinks, latrines, garbage, trash and scrap and radioactive waste. Examples of sanitation systems at polar bases are described in some detail. The section on heating discusses heating load, heat losses and insulation, energy sources, and heating systems. The ventilation section covers air demands, intakes and exhausts, ventilation of undersnow tunnels, and carbon monoxide problems. The report concludes with some notes on fire protection. Author (TAB)

N70-24731# Fraunhofer Institut, Freiburg (West Germany).
AN AEROBALLISTIC INSTALLATION FOR HYPERSONIC INVESTIGATIONS: CONSTRUCTION AND FIRST TEST RESULTS [EINE AEROBALLISTISCHE ANLAGE FUER HYPERSCHALLUNTERSUCHUNGEN. AUFBAU UND ERSTE VERSUCHSERGEBNISSE]
W. Merzkirch, A. Stilp, and H. Giesbrecht Nov. 1968 40 p refs In GERMAN
(Rept-10/68) Avail: CFSTI

A new hyperballistic installation consisting of a light gas gun and an aeroballistic measuring tube is described. The light gas gun was designed for 15 mm and 20 mm calibers and follows an approximate isentropic compression cycle. The measuring tube has 8 optical observation posts. The first alignment measurements on hypersonic projectiles are also reported. ESRO

N70-24820# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT Quarterly Report, Oct. – Dec. 1968
Kenneth C. Crebbin 16 May 1969 8 p refs
(Contract W-7405-eng-48)
(UCRL-18890; QR-60) Avail: CFSTI

The beam was on for 89.8% of the operating time this quarter and accelerated 2.4 × 10 to the 18th power protons. The Bevatron operated 123 12-hour periods of experimental high energy physics and integrated a total of 720 12-hour periods of experimental high energy physics. Three primary experiments were completed this quarter. Substantial improvements were made in reducing the fine structure of the long beam spills for counter experiments. Author (NSA)

N70-24931# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Raketenantriebe.
HIGH VACUUM IGNITION TESTS OF THE THIRD STAGE ROCKET MOTORS OF THE EUROPA 1 LAUNCH VEHICLE ON THE ROCKET TEST STANDS OF THE DFVLR IN LAMPOLDSHAUSEN [HOCHVAKUUMANFAHRVERSUCHE MIT TRIEBWERKEN DER DRITTEN STUFE DER EUROPA 1 AUF DEN RAKETENHOEHENPRUEFSTAENDEN DER DFVLR IN LAMPOLDSHAUSEN]
E. Matt 1969 16 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The vacuum rocket test stands developed for the third stage of the Europa 1 launch vehicle which are described. The procedure calls for the generation of a high vacuum prior to ignition and the maintenance of a lower vacuum during the ignition and burning tests. The vacuum chamber is separated from the diffuser which is blown by a special exploding mechanism. ESRO

N70-24970# France. Ministere de l'Air, Paris.
ELECTRIC SIMULATOR FOR THE STUDY OF OPTICAL PROPERTIES IN THIN MULTIDIELECTRIC LAYERS [SIMULATEUR ELECTRIQUE POUR L'ETUDE DES PROPRIETES OPTIQUES DES COUCHES MINCES MULTIDIELECTRIQUES]
Robert Badoual 1969 98 p refs In FRENCH
(Rept-451) Avail: CFSTI

An analog device using alternating current was developed to determine the reflection and transmission factors of a group of weakly absorptive thin multidielectric layers. Examples of structures possessing these properties are given. Emphasis is placed on the calculation of the layer stacks. Transl. by J.M.C.

N70-24978# Motorola Instrumentation and Control, Inc., Phoenix, Ariz.
INTEGRATED VISUAL AIDS CONTROL AND STATUS MONITORING SYSTEM Final Report
Gary E. Hampsch and Gary E. Williams Dec. 1969 61 p
(Contract FA-68-WA-1863)
(SRDS-RD-69-55) Avail: Issuing Activity

An integrated visual aids control and status monitoring system was installed to remotely control and monitor visual aids at the Federal Aviation Administration test facilities. The central station controls and monitors nine remote stations, with the capability of expanding to 90 remote stations. The remote stations utilize one of the three selected modes of communications: three operate on two-way FM radio, three operate on voice grade telephone lines, and three operate on power-line carrier equipment. The single central station can communicate with each remote station on it specific mode of communication. System and message security is

designed to prevent response to erroneous commands and spurious status signals. The central station initiates both visual and audible alarms in the event of uncommanded device changes, communications failure, and power failure. Each remote station has a battery backup to permit power failure message transmission. Author

N70-25004 European Organization for Nuclear Research, Geneva (Switzerland).
MULTILEVEL PLANNING IN FUNDAMENTAL RESEARCH [LA PLANIFICATION A PLUSIEURS NIVEAUX EN RECHERCHE FONDAMENTALE]
Gabriel Minder 9 Jan. 1970 92 p refs In FRENCH
(CERN-70-2) Copyright. Avail: Issuing Activity

The planning process for a large fundamental research laboratory is described. The process is based upon an information system which utilizes functional presentations of diverse activities and provides analytical model elements. It is shown that planning a research center is an integration of scientific disciplines which allows for the uniting of coordinating research and support. The European high energy research organization serves as a basis for illustration. Transl. by M.M.C.

N70-25101*# National Academy of Engineering, Washington, D.C.
CIVIL AVIATION RESEARCH AND DEVELOPMENT, AN ASSESSMENT OF FEDERAL GOVERNMENT INVOLVEMENT: AIRPORT AND SUPPORT FACILITIES
Dec. 1968 35 p refs
(Contract NSR-09-012-912)
(NASA-CR-109497) Avail: CFSTI CSCL 01E

It is concluded that in a favorable economic climate civil aviation can continue to flourish; in fact it can accelerate its beneficial growth if a carefully conceived program of planning and research and development aimed specifically at the civil air transport system is carried out. After considering the multiplicity of factors affecting the growth of civil aviation, it is concluded that the three most critical factors are (1) airport and support facilities, (2) noise, and (3) air traffic control. The most important recommendation pertains to knitting together more tightly the civil aviation research and development activities of the Department of Transportation, its major operating unit, the Federal Aviation Administration, and the National Aeronautics and Space Administration, and especially to dividing their responsibilities according to capability. The DOT should provide the leadership in conducting systems studies to identify, analyze, and rank civil aviation goals as well as the research and development needed to attain these goals; NASA should be responsible for research and development in all the areas of importance to civil aeronautics; and, the FAA should, in addition to operating the airways network, be responsible for the systems testing of the resulting operational concepts and hardware. Author

N70-25119# Joint Publications Research Service, Washington, D.C.
TRANSFORMER-TYPE HIGH-CURRENT ACCELERATOR
Ye. A. Abramyan et al 20 Mar. 1970 18 p refs Transl. into ENGLISH of the publ. "Silnotochnyy Uskoritelna Osnove Transformatora" USSR, Nucl. Phys. Inst. of Siberian Dept. USSR Acad. Sci., 1966 p 1–21
(JPRS-50119)

The operating principle of a direct-action accelerator designed to accelerate electrons to an energy of 1.5 megaelectron volts with an average beam power of tens of kilowatts and an efficiency of about 90 percent is described. The accelerator is a transformer with a core made up of insulated sections with a built-in accelerating tube operating on a 50 hertz network in a compressed gas environment. Constant electron energy is insured by voltage stabilization in the tube by means of current regulation. The pulse length of the electron current is regulated from zero to five milliseconds, and the repetition rate to 50 times per second. The mean current can reach 1/6 of the maximum current in the pulse. Magnetic lenses are installed in the tube to bring an electron current up to 100 milliamps through the accelerating tube in a beam with a diameter of several millimeters. Heavy metal shields near the tube axis protect the gas gaps and other electrically stressed sections of the accelerator from radiation. There is a structural description of a device in which an electron beam is obtained with an energy of 1.5 megaelectron volts and an average power of 25 kilowatts. Author

N70-25154# European Space Vehicle Launcher Development Organization, Paris (France).
THE ELDO EQUATORIAL BASE [LA BASE EQUATORIALE DU CECLES]
D. Bagaria *In* ESRO ESRO/ELDO Bull. No. 8 Jan. 1970 p 4–10 In FRENCH (See N70-25153 11-34)
Avail: CFSTI

The main features of the ELDO launching base at the French CNES space center in French Guiana near Kourou are outlined. The assembly and launching facilities and all auxiliary storage, control, and safety services are described. A special building is used for assembling the solid perigee stage of the Europa 2 launch vehicle, and toxic propellants are kept well away from the main launching and assembly blocks. ESRO

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-23915# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
STUDIES IN HOMOGENEOUS AND NONHOMOGENEOUS FREE TURBULENT SHEAR FLOWS
Nicholas P. Trentacoste and Pasquale M. Sforza Sep. 1969 150 p refs
(Contract AF 49(638)-1623)
(AD-696158; PIBAL-69-38; AFOSR-69-2151TR) Avail: CFSTI CSCL 20/4

An evaluation was made of the present state-of-the-art of turbulent mixing, by surveying the prevalent concepts and conclusions that have influenced research trends in this field. A critical discussion of the currently favored instruments used for obtaining measurements of the time mean properties of a turbulent flow is rendered; in addition, experimental evidence is presented to question the validity of such measurement techniques. A succinct description of the methodology utilized in ascertaining the consistency of experimental measurements with the particular properties of a given flow field is also discussed. An extension of the original Reichardt inductive theory of free turbulence is presented. This theory is utilized to solve the problem of a turbulent axisymmetric jet exhausting into a quiescent ambient under arbitrary initial conditions. The theory may be easily generalized to treat the more fashionable two stream mixing problem. Results of the analysis are compared with the mean property measurements of this investigation, and excellent agreement is obtained. Mean property measurements for initially axisymmetric and elliptic jets were obtained under isothermal, nonisothermal, homogeneous and nonhomogeneous conditions. Shadowgraph photography was employed to determine indicate its subsequent developments. Author (TAB)

N70-24006*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
VAPOR INGESTION PHENOMENON IN HEMISPHERICALLY

BOTTOMED TANKS IN NORMAL GRAVITY AND IN WEIGHTLESSNESS
Steven G. Berenyi and Kaleel L. Abdalla Washington Apr. 1970 25 p refs
(NASA-TN-D-5704; E-5410) Avail: CFSTI CSCL 20D

An experimental investigation was conducted in normal gravity and in a weightless environment to study the vapor ingestion phenomenon during outflow of liquid from hemispherically bottomed cylinders. The vapor ingestion heights in normal gravity and the critical heights in weightlessness were correlated with Froude and Weber number parameters, respectively. In the normal-gravity correlation, the Froude number parameter was modified by a tank-radius to drain-radius ratio. In the weightless tests, the Weber number parameter based on the outflow rate was used. Comparisons with data from flat-bottomed tanks are included, as well as data on liquid residuals at the time of vapor ingestion. Author

N70-24020# Technion-Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
A NOTE ON THE LATERAL MOTION OF THE TWO-DIMENSIONAL JET BOUNDARIES
I. Wygnanski and E. Gutmark Nov. 1969 13 p refs
(TAE-103) Avail: CFSTI

Two intermittency signals on each side of a two-dimensional jet were correlated to determine the manner in which boundaries of the jet move. With some minor reservations, it is concluded that each boundary moves independently of the other one. Author

N70-24027# Georgia Inst. of Tech., Atlanta. School of Engineering Science and Mechanics.
DYNAMICS OF PROPELLANT IN A SPINNING CONTAINER AND DESCRIPTION BY A MECHANICAL MODEL Final Report
Helmut F. Bauer and Shen-Shu Chang 30 Nov. 1969 160 p refs
(Contract DAAH01-69-C-0296)
(AD-698510; GIT-B-903-F) Avail: CFSTI CSCL 21/9

In missiles the largest amount of their weight is represented by propellant. Many of the spinning missiles exhibited unpredicted flight behavior, which in some cases could be described as effects of the sloshing of the spinning liquid. For this reason the behavior of the liquid in a spinning annular cylindrical container with only a slightly deviating free liquid surface was treated for free oscillations and forced translational as well as pitching oscillations. A mechanical model was also derived for a simplified description of the liquid motion in a spinning tank. It also serves the introduction of linear damping. The location and size of a baffle is presented for the purpose of propellant confinement in the case of sudden longitudinal acceleration change. Author (TAB)

N70-24049# Naval Ship Research and Development Center, Washington, D.C.
ON LAMINAR FLOWS PAST OBLATE SPHEROIDS OF VARIOUS THICKNESSES Final Report
Yermiyahu Rimon and Hans J. Lugt Nov. 1969 33 p refs
(AD-699496; NSRDC-3036) Avail: CFSTI CSCL 20/4

The effect of high surface curvature of bodies on a surrounding laminar flow field is studied by means of steady axisymmetric flows past oblate spheroids of various thicknesses. For vanishing Reynolds number the Oberbeck solution is discussed. For nonzero Reynolds numbers R or = 100 a numerical program is used which was recently developed by Rimon. The numerical stability of this finite-difference scheme deteriorates rapidly as the oblate spheroids become very thin. For both Reynolds numbers 0 and 10 two different types of flows are observed, depending on the thickness of the body. For sphere-like oblate spheroids the surface pressure has a maximum at the stagnation point, whereas for disk-like bodies this maximum moves towards the edge with decreasing thickness. However, for R = 100 the maximum pressure is always at the stagnation point, no matter how thin the body is. In the limiting case of the infinitely thin disk the edge becomes a singular body point. Although this limit could not be examined for nonzero Reynolds numbers with the numerical scheme used, the trend in the behavior of the solutions as the thickness decreases is discussed. From a previous analysis of the nature of possible solutions near a singular point, it appears from the numerical results that for R = 100 the flow is regular at the edge. Since for R = 0 the solution is weakly singular (pressure and vorticity are infinite at the singular body point), a change in the flow characteristics must occur between R = 0 and R = 100. Author (TAB)

N70-24176# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
INSTABILITY OF A VORTEX SHEET LEAVING A SEMI-INFINITE PLATE
S. A. Orszag and S. C. Crow Jan. 1970 31 p refs
(D1-82-0953) Avail: CFSTI

The growth of undulations along an infinite vortex sheet is a classical problem of stability theory. Here we modify that problem by including the effects of a boundary: the vortex sheet is assumed to leave a rigid semi-infinite plate and to undergo spatially growing undulations downstream. The usual solution for a doubly infinite sheet is corrected by the Wiener–Hopf technique to account for the presence of the plate. The correction depends sensitively on whether a Kutta condition is enforced at the trailing edge. Two Kutta conditions, called rectified and full, are suggested to apply depending on conditions in the unperturbed flow. In either case, the correction due to the plate becomes negligible half a wavelength downstream from the trailing edge. Author

N70-24195# Ballistic Research Labs., Aberdeen Proving Ground, Md.
QUALITATIVE INTERFEROMETRY OF EXPANDING METAL VAPOR
F. D. Bennett, G. D. Kahl, and F. N. Weber, Jr. Oct. 1969 31 p refs
(AD-699313; BRL-1454) Avail: CFSTI CSCL 19/1

Single and multiple fringe interferograms have been in use in recent years to obtain gas and electron distributions about an exploding wire. Until recently not much quantitative evidence has been obtained about the flow of the metal vapor produced by exploding wires. The purpose of this paper is to establish some geometrical techniques and mathematical relations upon which subsequent analyses of this metal vapor flow, seen in the existing interferograms, may be based. This paper offers certain flow hypotheses, shows the resulting fringe contours for both the single and multiple fringe cases, and compares these fringe contours with some interferograms obtained experimentally. Author (TAB)

N70-24201# Stevens Inst. of Tech., Hoboken, N.J.
MODEL TESTS OF HYDROFOIL-EQUIPPED FLOATS
Robert L. Van Dyck Oct. 1969 17 p
(Contracts N600(29)26908; N00600-68-C-0408)
(AD-699136; SIT-DL-69-1347) Avail: CFSTI CSCL 1/3

The report presents the results of a brief series of tests conducted on scale models of typical, fixed-float aircraft alighting gear retrofitted with two different hydrofoil arrangements -- one with a foil on each float and a second with the foil between the two floats. In addition, tests were conducted on the bare float configurations to provide a basis for comparison. In water-based aircraft design it has been found that the addition of a small hydrofoil beneath the keel of a hull often improves its take-off and landing characteristics. Because of this past success, it was proposed that consideration be given to modifying existing floats by the addition of small submerged hydrofoils. Accordingly, the study was undertaken to investigate the possible hydrodynamic advantages that may result from the retrofit of a hydrofoil to float-type alighting gear. The major emphasis of the test program was to optimize the location, attitude and extension of the hydrofoil relative to the float installation. Since the study was of an exploratory

nature, comparisons were based on constant-thrust accelerated take-off tests with a brief check made on the calm water constant-speed resistance characteristics of each system. Author (TAB)

N70-24211# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
MEASUREMENTS OF THE VIBRATIONAL RELAXATION RATES OF NITROGEN AND OXYGEN Final Report
Anthony L. Russo Dec. 1969 40 p refs
(Contract F44620-68-C-0011)
(AD-699239; CAL-AF-2567-A-2; AFOSR-69-3038TR) Avail: CFSTI CSCL 7/4

An infrared diagnostic method has been developed and used to observe the vibrational relaxation of N2 using CO additive and O2 using H2O additive. Relaxation rate data for both N2 and O2 are obtained behind shock waves which are in very good agreement with other published data. Similar measurements in nozzle expansion flows of N2 indicate lower vibrational temperatures than anticipated on the basis of the shock-wave data. This work was done as an experimental study of thermal nonequilibrium which can occur in air and its component gases. Author (TAB)

N70-24275*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILITY OF A FLOWING SYSTEM USING INFORMATION THEORY
N. Stankiewicz Washington Apr. 1970 8 p refs
(NASA-TM-X-1969; A-3406) Avail: CFSTI CSCL 20D

The principle of maximum entropy (disorder) is extended to the nonequilibrium situation of viscous flow and a condition for "thermodynamic" stability is found. Violation of this condition coincides with boundary layer separation in a Newtonian fluid. Author

N70-24323*# United Aircraft Corp., East Hartford, Conn. Research Labs.
SYSTEMATIC TWO-DIMENSIONAL CASCADE TESTS. VOLUME 2: MULTIPLE CIRCULAR-ARC HYDROFOILS
W. E. Taylor, T. A. Murrin, and R. M. Colombo 6 Apr. 1970 158 p
(Contract NAS3-4184)
(NASA-CR-72499; UARL-J910254-56) Avail: CFSTI CSCL 20D

Performance parameters and cavitation indices are presented for cascades of hydrofoils with double and multiple circular-arc profile sections tested over a range of systematically introduced variables in a rectilinear cascade tunnel which uses water as the test medium. Cascade configurations included various combinations of an inlet flow angle, a cascade solidity, and angles of incidence between positive and negative stall. The incidence and deviation angles corresponding to the point of minimum total pressure loss coefficient were correlated, and the turning angles are presented in a form which makes it possible to determine the turning angles for arbitrary cascade configurations. The minimum loss incidence and deviation angles and the hydrofoil pressure distributions for multiple and double circular-arc hydrofoils are also presented for comparison. Author

N70-24334# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
APPLICATION OF THE KARMAN-TSIEN GAS THEORY TO HIGH SUBSONIC AND TRANSONIC NON-CIRCULATORY FLOWS OVER QUASI-ELLIPTICAL AIRFOIL SECTIONS: RESULTS OF AN ITERATIVE COMPUTATION METHOD
J. W. Boerstoel 27 Feb. 1968 17 p refs
(NLR-TR-68037-U) Avail: CFSTI

An iterative method for the computation of non-circulatory flows of the Karman-Tsien gas over airfoil sections is presented. Within three or four steps the method converges to results with sufficient precision to be acceptable from an engineering point of view. The computational method has been used to get some insight into the value of the Karman-Tsien gas theory for estimating compressibility effects in high subsonic and transonic flows. To this end, the results have been compared with exact results of quasi-elliptical airfoil sections, (gamma = 1.4, MO.75). The comparison demonstrated the Karman-Tsien gas theory to give better results than the compressibility rule proposed by Tsien. Author (ESRO)

N70-24336# Salford Univ. (England).
THE EQUATIONS OF MOTION OF A VISCOUS COMPRESSIBLE GAS REFERRED TO AN ARBITRARILY MOVING CO-ORDINATE SYSTEM
F. Walkden London Aeron. Res. Council 1969 26 p refs Sponsored by Min. of Aviation
(STV-R/M-3609; RAE-TR-66140; ARC-28228) Copyright. Avail: CFSTI

The equations of motion of a viscous, compressible, heat conducting fluid are formulated in general coordinates. A tensor form for the equations of motion in a fixed cartesian system is derived and the methods of tensor analysis are used to obtain the appropriate representation of the equations of motion in a general coordinate system. Two examples are considered to show how the analysis presented may be used to obtain equations of motion appropriate to each case. Author (ESRO)

N70-24370# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
AN INVESTIGATION OF FLUIDIC RESISTORS
J. H. T. Wu and P. Ostrowski Mar. 1970 14 p refs
(Grant NRC A-1255)
(TN-70-1) Avail: CFSTI

Fluidic resistors of rectangular cross section and variable length were tested with air as the working fluid. In contrast to what might be expected for smooth circular pipes, fluidic resistance was found to vary nonlinearly with the channel length. The experiments indicated a power law relationship between friction factor and Reynolds number but empirical constants for the power law were found to vary considerably with the channel dimensions. Author

N70-24394# Asian Inst. of Tech., Bangkok (Thailand).
DIFFUSION OF MULTIPLE JET STREAM
Charoen Boonyajantranon (M.S. Thesis) 1968 90 p refs
Avail: CFSTI

The characteristics of a multiple two-dimensional jet system was investigated by using water as both the jet and ambient fluid. When the jet spacing is great, the flow behaves as a single jet. When the jet spacing decreases, the flow approaches uniform conditions. The investigation reveals that the momentum flux is not constant and the pressure distribution within the flow region is not hydrostatic as in the case of the single jet flow. There exists a profound relationship among tangential shear, pressure, and momentum which governs the other characteristics of the flow. The constant of jet spreading for a multiple jet system varies with the ratio of jet spacing and the values for particular jet systems are given. An equation is fitted to this variation which makes it possible to get the value for any system of jet until the limiting condition of single jet flow is reached. The determination of volume and energy flux for any system of jet can be made by substituting the constants for that system into the equation. Author

N70-24401# Asian Inst. of Tech., Bangkok (Thailand).
FORCES OF SUBMERGED JETS ON RIGID CIRCULAR DISKS
Rodolfo Corpuz Undan (M.S. Thesis) 1969 59 p refs *Its* Thesis No. 265
Avail: CFSTI

The drag forces produced by submerged turbulent round jets on circular disks, oriented axisymmetrically and normally to the flow, were investigated. The drag coefficient was expressed in

terms of the density, nozzle diameter and velocity. Variations of drag coefficients were determined as a function of the nozzle diameter, nozzle jet velocity, disk diameter, and the centerline distance of the disk from the origin of the jet. A theory was developed to describe the drag force on the circular disk. The measured data were found to agree closely with the theoretical results for most flow conditions. Curves are presented in dimensionless form describing the theoretical and experimental results. Author

N70-24421# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
THE TWO DIMENSIONAL MIXING REGION
I. Wygnanski and H. E. Fiedler Feb. 1970 80 p refs
(D1-82-0951) Avail: CFSTI

The two dimensional incompressible mixing layer was investigated by using constant temperature, linearized hot wire anemometers. The measurements were divided into three categories: (1) the conventional average measurements, (2) time average measurements in the turbulent and the nonturbulent zones, and (3) ensemble average measurements conditioned to a specific location of the interface. The turbulent energy balance was constructed twice, once using the conventional results and again using the turbulent zone results. Some differences transpired between the two sets of results. It appears that the mixing region can be divided into two regions, one on the high velocity side which resembles the outer part of a wake and the other on the low velocity side which resembles a jet. The binding turbulent-non-turbulent interfaces seem to move independently of each other. There is a strong connection between the instantaneous location of the interface and the axial velocity profile. In spite of the complexity of the flow, the simple concepts of eddy viscosity and eddy diffusivity appear to be valid within the turbulent zone. Author

N70-24478# ARO, Inc., Arnold Air Force Station, Tenn.
AXIALLY SYMMETRIC, INVISCID, REAL GAS, NON-ISOENERGETIC FLOW SOLUTION BY THE METHOD OF CHARACTERISTICS Final Report, Jun. 1967 - Jun. 1968
John H. Fox (M.S. Thesis) AEDC Jan. 1970 63 p refs Tenn. AEDC Jan. 1970 63 p
(Contract F40600-69-C-0001)
(AD-699199; AEDC-TR-69-184) Avail: CFSTI CSCL 20/4

A numerical procedure is presented for the solution of the characteristic equations for a non-isoenergetic, supersonic, real gas jet expanding into a constant pressure ambience. Included is a procedure for inserting the expansion fan and the embedded shock. Examples are given for high temperature argon jets with radiation. Author (TAB)

N70-24482 Minnesota Univ., Minneapolis.
SCALAR TRANSPORT ACROSS WAVY LIQUID LAYERS
Edgard Souza-Aguiar Vieira (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-20067

The problem of transfer across a liquid layer agitated by surface waves is considered. When the wave model is taken to be irrotational, progressive and of permanent form an exact solution is found for the boundary value problem through the use of curvilinear coordinates (stream coordinates). For the case of irrotational standing waves material coordinates are used. Preliminary results are presented to the approximation solution developed. Dissert. Abstr.

N70-24492 Tulane Univ., New Orleans, La.
VERIFICATION AND APPLICATION OF THE DUSTY GAS MODEL
Laurin William Warren (Ph.D. Thesis) 1969 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-20509

The extent of validity and range of application of the dusty gas model for describing diffusion and laminar flow in porous solids was examined. Porous solids most closely corresponding to a dusty gas, namely solids composed of lightly fused spheres were used. The model was capable of describing diffusion and laminar flow accurately if the parameters were determined experimentally. It was found that the tortuosity for Knudsen diffusion was not equal to that for ordinary diffusion. The Knudsen tortuosity was 1.7 times higher. The previously unexamined effect of particle size was found to be in complete accord with the prediction of the model. The diffusion, bulk flow, laminar flow and momentum balance contributions of the dusty gas model are applied to a heterogeneous reaction in a spherical pellet in order to study the effect of a change in moles and the resultant pressure gradient on isothermal effectiveness factors. An increase in moles influenced the effectiveness factor most in the ordinary diffusion region. Dissert. Abstr.

N70-24528 Arizona State Univ., Tempe.
AN INTEGRAL SOLUTION FOR THE THREE-DIMENSIONAL, LAMINAR FLOW OF A VISCOUS, INCOMPRESSIBLE FLUID BETWEEN PARALLEL, CO-ROTATING DISKS
Brent Evans Boyack (Ph.D. Thesis) 1969 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20753

The three-dimensional, laminar, radially inward through-flow of an incompressible, Newtonian fluid between parallel, co-rotating disks has been studied using an integral solution technique. The problem statement consists of the order-of-magnitude reduced forms of the Navier-Stokes equations and appropriate boundary conditions. The integral solution compares well with those of previous investigators and offers a distinct advantage over the previous techniques in the case of solution for cases including both the inlet and asymptotic flow regimes. The solutions for fourth, sixth, and eighth order polynomial representations of the velocity components have been generated. Dissert. Abstr.

N70-24533 Utah State Univ., Logan.
HYDRODYNAMIC FORCES AND PRESSURE FLUCTUATIONS ON A HEMISPHERE ON A BOUNDARY IN VELOCITY GRADIENT FLOW CONSIDERING FREE SURFACE EFFECTS
Talaat M. Owais (Ph.D. Thesis) 1968 324 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No. 69-10112

Temporal mean steady pressure distribution is measured on a hemisphere under different flow conditions. The characteristics of the pressure distribution and its relationship to the main flow parameters are presented. Drag, total lift, net lift, dynamic lift and net dynamic lift are presented using mean pressure distribution data with and without free surface effects in two locations along the flume. The effect of boundary layer growth on the flow condition is discussed. A velocity profile paramater in different forms is defined and is shown to be related to drag coefficient. None of the velocity profile parameters were found to have a significant effect on lift. Other pressure terms are presented and are shown to correlate with the lift and drag. Experimental investigation of the double separation pattern is presented which demonstrates the complexity of the unsteady flow pattern. Dissert. Abstr.

N70-24572# Advanced Technology Labs., Inc., Jericho, N.Y.
MIXING AND COMBUSTION OF SOLID PARTICLES IN TURBULENT STREAMS
Paolo O. Baronti and Antonio Ferri (New York Univ.) *In* AGARD Reactions Between Gases and Solids Feb. 1970 15 p refs
Supported by Thiokol Chem. Corp. (See N70-24551 11-06)
Avail: CFSTI

The problem of mixing and combustion in adjacent turbulent streams, one of which contains solid particles, is analyzed. The analysis considers the response of solid particles to the spectrum of

turbulent fluctuations in the surrounding medium, and determines the turbulent transport properties of particle clouds in terms of particle size, characteristic flow time and properties of the surrounding flow field. The conservation equations for turbulent mixing are then derived. Various particle sizes are considered, resulting in a multi-component particle diffusion process. Also, a new mechanism for particle combustion, based on the relative turbulent velocity between the particles and their surrounding oxidizing medium, is analyzed. The conservation equations are amenable to numerical integration; numerical examples are given, which show the characteristics of the particle diffusion and combustion process. Author

N70-24589# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ONE DIMENSIONAL APPROXIMATION SOLUTION OF A VARIATIONAL PROBLEM ON DESIGN OF A MAXIMUM THRUST NOZZLE WITH FOREIGN PARTICLE GAS FLOW

A. N. Kraiko et al 4 Sep. 1969 21 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Izv. Mekhan. Zhidkost i Gaza, (USSR), no. 4, 1968 p 52-62

(AD-699121; FTD-HT-23-195-69) Avail: CFSTI CSCL 20/4

A study was made of the design of an optimal nozzle configuration in a flow of gas containing heterogeneous particles. On the basis of a series of differential equations, the solution is presented in a one-dimensional approximation. Graphical results of the solution are given. A comparison of the results shows that a higher nozzle efficiency is obtained by a shift of the maximum particle lag from the throat region toward the subsonic region. The absence of a direct relationship between relative particle lag magnitudes and impulse losses was noted. Author (TAB)

N70-24698# Eidgenossische Technishe Hochschule, Zurich (Switzerland).

PRESSURE DROP AND HEAT TRANSFER IN THE TWO-PHASE FLOW OF FREON-12

Jose Ricardo Napadensky (Ph.D. Thesis) 1969 77 p refs *Its* Dissertation No. 4285

Avail: CFSTI

Many attempts have been made to develop correlations for the accurate prediction of the pressure drop, void fraction and heat transfer in two-phase flow. Among them is the Lockhart-Martinelli correlation which, although used for the first time almost twenty years ago, still remains as the most widely used correlation for pressure drop and void fraction. However, a serious deficiency in most of those correlations is that they do not sufficiently account for the influence of the various patterns on the predicted pressure drop, void fraction and heat transfer parameters. The purpose of this investigation is to obtain pressure drop and heat transfer measurements and correlate them over a wide range of flow conditions, system pressure and heat input in a vertical up cocurrent, two-phase mixture using Freon-12 as the component under study. Special analysis of the flow patterns was conducted by means of visual and photographic observations. Author

N70-24736# Office National d Etudes et de Recherches Aerospatiales, Paris (France).

EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYER TRANSITION IN HYPERSONIC FLOW [EXPERIMENTELLE UNTERSUCHUNG DES GRENZSCHICHTUMSCHLAGS IM HYPERSCHALL]

Roger Michel and Volker Schmitt 1969 24 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

Hypersonic wind tunnel studies give information on the boundary layer transition at higher flow velocities. In particular, they underline the important influence of the unit Reynolds number, the increase of which results in an essential increment of the transition Reynolds numbers. In addition, measurements on bodies of revolution show a nonnegligible influence of sharp body form on the position of the transition range. It appears that the transition Reynolds number parameter is the Mach number for the steady external flow in which the transition takes place. Boundary layer measurements give a coherent survey of the velocity profiles of a boundary layer in transition. They show that the boundary layer properties in the range beyond the end of the transition, still are clearly remote from those of a fully turbulent boundary layer. ESRO

N70-24764 Catholic Univ. of America, Washington, D.C.

DECAY OF WEAK TURBULENT FIELD

Thomas Tsung-Tse Huang (Ph.D. Thesis) 1969 69 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-19752

A detailed experimental investigation of the structure of weak turbulence generated by various single- and multiple-stage grids has been made. The weak turbulent fields were limited to those having no interaction with the mean flow field. The present study covers a range of Reynolds numbers of turbulence between 70 and 7. Components of turbulence were found to have equipartition of energy in the final stage of decay. When the Reynolds number of the turbulence is < 30, the kinetic energy of turbulence decreases inversely as the square of decay time. All the length scales of turbulence increase as the square root of time, while the Reynolds number of turbulence decreases as the square root of time. Both the measured spectral and correlation functions showed self-preserving forms that were not in agreement with those predicted by the normal statistics of turbulence. Dissert. Abstr.

N70-24787*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INTERNAL PRESSURES OF A SPACECRAFT OR OTHER SYSTEM OF COMPARTMENTS, CONNECTED IN VARIOUS WAYS AND INCLUDING OUTGASSING MATERIALS, IN A TIME-VARYING PRESSURE ENVIRONMENT

John J. Scialdone Aug. 1969 89 p refs

(NASA-TM-X-63889; X-327-69-524) Avail: CSCL 20D

A method of calculating the pressure profile for each compartment of a multi-compartment system such as a spacecraft is presented. The method is applicable to volumes connected in series or in parallel or both by passages of various sizes and geometries, where each volume may include several materials outgassing according to known or assumed characteristics. An appropriate set of differential equations with variable coefficients is derived, which may be solved by computer to provide pressure profiles for each compartment. The profiles obtained are the result of viscous, intermediate, and molecular flow regimes experienced under appropriate conditions in the system of volumes and passages. Several computations which have been made are presented and compared to experimental results. Pressure profiles for volumes with various outgassing materials and various orifice sizes have been calculated and are grouped according to the molecular flow regime time constants and the outgassing characteristics of the material. Author

N70-24788*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPERIMENTAL INVESTIGATION OF BOUNDARY-LAYER TRANSITION ON A 10 deg HALF-ANGLE CONE AT MACH 6.9

Michael C. Fischer Washington Apr. 1970 64 p refs

(NASA-TN-D-5766; L-6940) Avail: CFSTI CSCL 20D

An experimental investigation was made of the effect of mass addition, local unit Reynolds number, nose bluntness, and angle of attack on the transition Reynolds number for a 10 degree half-angle cone with a ratio of wall to total temperature of about one-half. The tests were conducted at a Mach number of 6.9 and a free-stream unit Reynolds number range of 1.68 million to 6.26 million per foot. The results showed a significant reduction in transition Reynolds number owing to mass addition by using a

low-temperature ablator. There was a significant influence of local unit Reynolds number on transition. The present data did not agree with a correlation which attempts to predict the Reynolds number for the end of transition. Correlations of transition Reynolds number with hypersonic Mach number were shown to be highly dependent on tunnel size (noise level). Transition moved forward on the leeward side of the sharp cone at angle of attack and rearward on the windward side. Transition occurred only on the leeward side of the blunted-cone configurations at angle of attack and was displaced rearward of the equivalent sharp-cone transition location. At large angle of attack there was a diminishing effect of bluntness on displacing transition rearward. Longitudinal grooves observed on the surface of the ablated models were believed to be formed by an array of streamwise Gortler-type vortices. Author

N70-24897# Douglas Aircraft Co., Inc., Long Beach, Calif.
TWO-DIMENSIONAL POTENTIAL FLOW THEORY FOR MULTIPLE BODIES IN SMALL AMPLITUDE MOTION
Joseph P. Giesing 30 Sep. 1969 30 p refs *Its* Douglas Paper-5369
(Contract NONR-4308(00))
(AD-698808) Avail: CFSTI CSCL 20/4

The paper describes a very general method for determining the unsteady, two-dimensional, incompressible flow about one or more bodies of arbitrary shape. Specifically the surface pressure, forces and moments are obtained for bodies oscillating with small amplitude about their steady equilibrium position and on bodies in small amplitude gust fields. The equilibrium configuration of the bodies may also be arbitrary. Calculated results for single bodies in and out of gust fields are compared to results obtained by existing methods. Calculations and comparisons are also presented for two interacting bodies. Author (TAB)

N70-24909# Los Alamos Scientific Lab., N.Mex.
NUMERICAL METHODS FOR FLUID DYNAMICS, AN ANNOTATED BIBLIOGRAPHY
Francis H. Harlow Sep. 1969 10 p refs
(Contract W-7405-eng-36)
(LA-4281) Avail: CFSTI

The contents of numerous publications in the field of numerical fluid dynamics are briefly described. Emphasis is on papers describing methodology for transient problems in several space dimensions. Author (NSA)

N70-24945# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany)
THEORETICAL INVESTIGATION OF DIFFUSION IN RAREFIED GASES [ZUR THEORETISCHEN BEHANDLUNG DER DIFFUSION IN VERDUENTEN GASEN]
H. Lang 1968 82 p refs In GERMAN Prepared jointly with Aerodyn. Versuchsanstalt, Gottingen
(MITT-83-1968) Avail: CFSTI

With the aid of a Krook-model for a binary gas mixture and the half range moment method, the diffusion near a single wall (half-space problem) and between two infinite parallel plates (slit diffusion) is investigated. The total pressure and the temperature are assumed constant. Improved formulas for the diffusive slip are obtained and compared with experimental data. A reversal diffusive slip effect occurring experimentally in the system A/CO2 and not predicted by elementary theory, is reproduced correctly by this one. Molecular flows over a range from very low (high pressure) to very high (low pressure) Knudsen numbers are calculated for the slit diffusion. When the mean free path length and the wall interactions of both components are equal a relation between the molecular flows of the components is obtained which is valid for all Knudsen numbers. ESRO

N70-24985 Polytechnic Inst. of Brooklyn, N.Y.
ON THE STABILITY OF SHOCK WAVES WITH VISCOSITY AND HEAT CONDUCTION
Alvin J. Paullay (Ph.D. Thesis) 1969 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-20358

Solutions to the unsteady Navier-Stokes equations for a perfect gas with viscosity and heat conduction are assumed in the form of a steady state solution added to an unsteady perturbation. The steady state solution is taken to be a shock wave with a continuous structure as determined by the steady Navier-Stokes equations. Assuming linear perturbations, the latter may be set in the form of the product of an exponential time function and an unknown space function. The problem of stability of a normal shock wave is then formulated in the form of a set of three linear, homogeneous, ordinary differential equations with an Eigenvalue. The solutions are expanded in powers of a parameter which denotes the shock strength. The first order solution is shown to lead to a hypergeometric equation. It is also shown that the linearly perturbed Burgers' equation leads to exactly the same hypergeometric equation as derived herein. A general closed form solution of this equation is obtained, and it shown from this solution that weak shock waves are stable. Dissert. Abstr.

N70-24988 Arizona State Univ., Tempe.
AN EXPERIMENTAL INVESTIGATION OF THE INWARD FLOW OF AN INCOMPRESSIBLE VISCOUS FLUID BETWEEN PARALLEL CO-ROTATING DISKS
Robert Gwillam Adams (Ph.D. Thesis) 1969 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-20748

The primary purpose of this dissertation was to investigate experimentally the inward flow of an incompressible viscous fluid between two closely spaced parallel co-rotating disks, and to compare the experimental results with the results of recent analytical investigations of this flow configuration. A secondary objective was to attempt to detect the transition of initially laminar flow between the disks to turbulent flow. The flow configuration represents the flow between two disks of a multiple-disk turbine which has a rotor consisting of a large number of similar passages. The flow field investigated corresponded to the full-admission form of the turbine, in which fluid is admitted with both radial and tangential components of velocity that are uniform in the circumferential direction. The fluid left the passage through a system of ports arranged around the shaft on which both disks were rigidly mounted. Dissert. Abstr.

N70-25009 Washington Univ., Seattle.
THE INSTABILITY OF CAPILLARY JETS
Arthur Mac Lean Sterling (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-20278

A critical review of the literature reveals a pattern which suggests that the breakup mechanism of laminar capillary jets can be altered by the destabilization effects of velocity profile relaxation. An experimental program has been carried out to study the breakup of jets which are free from these effects. Special nozzles were designed to form jets with initially uniform velocity profiles. The behavior of these jets is compared to the behavior of jets with fully developed laminar profiles and to that predicted by Weber's analysis. This comparison shows: 1. The state of the initial velocity profile has a significant effect on the breakup behavior of jets with low viscosity. 2. This effect is diminished as the viscosity is increased. 3. Weber's analysis overestimates the aerodynamic effects. A semiempirical modification of Weber's result is made to account properly for the aerodynamic effects (including the viscosity of the ambient fluid). Dissert. Abstr.

N70-25011 Virginia Polytechnic Inst., Blacksburg.
LAMINAR HYPERSONIC BOUNDARY-LAYER SLIP FLOW PAST A SEMI-INFINITE FLAT PLATE WITH DISPLACEMENT THICKNESS INTERACTION

Rong-Shuang Wang (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-19987

The first order solution for the laminar hypersonic boundary layer flow over a flat plate at constant wall temperature is given. The effect of slip at the wall as well as the interaction between the boundary layer flow and outer stream flow are taken into consideration. Boundary layer equations are used to provide the flow profiles while the tangent-wedge approximation is used to provide the boundary conditions at the outer edge of the boundary layer. The viscous flow and exterior inviscid flow are matched to first order by a process of iteration. The slip solution at the leading edge was found analytically. Making use of the parabolic nature of the boundary layer equations and using the slip solution to determine the initial flow profiles, solutions have been found integrating from the leading edge downstream. A finite difference scheme is employed to solve the differential equations numerically. Temperature and velocity profiles are obtained by solving the linearized difference equations simultaneously with iteration process, until convergence to the solution of the nonlinear difference equations is achieved. Dissert. Abstr.

N70-25018 New York Univ., N.Y.
INCOMPRESSIBLE CNOIDAL WAVES IN CIRCULAR TROUGHS
Lester Spielvogel (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-21275

The incompressible flow of fluid in circular troughs or circular channels is dealt with. Fluid circulates through these troughs and is contained in them by the action of a gravitational body force. Under certain velocity conditions permanent waves of large magnitude and constant angular velocity may be solutions to the differential equations of motion. These waves are closely related to the cnoidal and solitary waves of the infinite straight channel. Expressions for their shape, the critical velocity condition and their relation to waves in straight channels are derived and discussed. The irrotational case is thoroughly exhausted, and some important categories of rotational waves are also treated. Dissert. Abstr.

N70-25066# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
FUNDAMENTALS OF THE CALCULATION OF FLOWS OF COMPRESSIBLE MEDIA IN ROTATING CHANNELS [BERECHNUNGSGRUNDLAGEN FUER DIE STROEMUNGEN KOMPRESSIBLER MEDIEN IN ROTIERENDEN KANAELEN]
J. T. Heynatz and E. Herpfer 1969 73 p refs In GERMAN
Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

Laws are derived governing the adiabatic and isothermal friction flow of compressible media through cylindrical tubes. Owing to centrifugal and Coriolis forces, the flow distribution is more complicated than in a tube at rest. Under certain conditions approximations of the original equations can be used which are accessible to analytical solutions. By comparison with the corresponding incompressible phenomena, the Coriolis effect and the influence of the channel cross section are discussed. ESRO

N70-25083# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
SIZING VENT TO DUMP ORIFICE IN AREA 6 MK.3 LOX SYSTEM
J. H. R. Towie Dec. 1969 12 p refs
(WRE-TN-DWD-29) Avail: CFSTI

This technical note describes the tests carried out during 18 and 19 November, 1969 to establish the correct orifice size as specified. Author

N70-25100# Lockheed Missiles and Space Co., Huntsville, Ala.
HYPERSONIC FLOW AROUND A SPHERE IN THE PRESENCE OF STRONG BLOWING THROUGH THE FRONT SURFACE
A. P. Komashenko et al 23 Dec. 1968 4 p refs Transl. into ENGLISH from Dopovidi an Ukr. (SSR), no. 12, 1969 p 1115 - 1118
Avail: CFSTI

Hypersonic viscous gas flow for large values of Reynolds number is studied as an effective heat-shielding method for bodies moving at very high velocities. The motion modes are investigated with very strong blowing through the front surface for which using the boundary layer theory is impossible. Using the Navier-Stokes equation, and applying the Newtonian theory in the neighborhood of the stagnation point, the solution of the shock layer thickness is derived. It is concluded that the solution is useful in problems in which the thickness of the layer of injected gas must be known; as in the problem of absorption of air radiation by injected gas. F.O.S.

N70-25106# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.
FLUIDICS: THE CHARACTERISTICS OF A SIMPLE VORTEX FLOW MODULATOR
B. G. Catchpole Nov. 1969 15 p refs
(ARL/ME-310) Avail: CFSTI

The pressure and flow characteristics of a simple vortex flow modulator were experimentally determined at pressures a little above ambient using air as the working fluid. The vortex chamber was one inch in diameter and had single supply, control and outlet ports. The results are compared with those of other studies. Author

N70-25138# Bureau of Mines, Morgantown, W. Va. Petroleum Research Lab.
GAS FLOOD EFFICIENCY IMPROVEMENT BY POLYMER INJECTION Technical Progress Report
Edward L. Burwell and Arlen E. Hunt Mar. 1970 11 p refs
(BM-TPR-23) Avail: Issuing Activity

The use of dilute polymer in brine solutions to increase the efficiency of air in gas flooding model oil reservoirs was investigated. Slugs (0.23 pore volume) of 500 ppm polyacrylamide were injected into a model, consisting of a high and a low permeability core, that was previously gas flooded to residual oil. Gas flooding was then resumed. Of the total gas volume injected, the percentage entering the high permeability zone was greatly reduced after polymer injection but remained unchanged when slugs of water without polymer were used. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-23813# Geological Survey, Denver, Colo.
RECONNAISSANCE GRAVITY SURVEY OF THE RAT ISLANDS, WITH EMPHASIS ON AMCHITKA ISLAND, ALASKA
C. H. Miller, J. D. Kibler, and T. J. Tuttle Sep. 1969 11 p refs
(Contract AT(29-2)-474)
(USGS-474-49) Avail: CFSTI

A gravity survey of 338 stations is presented as two simple Bouguer maps. The data show the similar gravimetry of Rat and Amchitka Islands with a regional gradient that decreases to the north at a rate of 0.5 to 1.5 mgals per mile. A gravity high at the east end of Amchitka Island and a low at the west end (a difference of 44 mgals) are anomalous compared to the gravity of its central part and to that of Rat Island. Author (NSA)

N70-23942# Washington State Univ., Pullman. Dept. of Agronomy.
WATER CONTENT AND SOIL BULK DENSITY MEASURED CONCURRENTLY USING TWO GAMMA PHOTON ENERGIES
Walter H. Gardner, Gaylon S. Campbell, and C. Calissendorff 1969 42 p refs
(RLO-1543-6) Avail: CFSTI

Using gamma photons from Am-241 at 0.060 MeV and Cs-137 at 0.661 MeV collimated in a beam and attenuated in 10-cm soil columns, the standard deviation in both water content and bulk density measurements is about 0.007g/cu cm for one million counts measured in air and about 0.005 g/cu cm for 2.5 million counts. Using a 500-mC gamma source and a 6.7 sq mm collimating slit, one million counts in air can be obtained in about 1 minute. The random nature of gamma photon emission is the major factor limiting precision for counting periods of a few minutes. As greater counts are used the precision becomes limiting. If the variance due to random emission is reduced to the same magnitude as that associated with measurement of column thickness or attenuation coefficients precision limit would be about 0.0035 g/cu cm at mid range values of water content and bulk density. Collimator and shielding requirements along with an analysis of errors are given. Author (NSA)

N70-23996# Army Engineer Nuclear Cratering Group, Livermore, Calif.
NATURAL RUBBLE SLOPES AND THEIR RELEVANCE TO CRATER FALLBACK SLOPES Final Report
Richard J. Lutton Sep. 1969 192 p refs
(AD-699412; NGG-TR-14) Avail: CFSTI CSCL 13/2

The purposes of the investigation are: (1) to describe the properties and characteristics of natural rubble deposits, (2) to discuss the degree to which similar characteristics will be present in crater rubble slopes, and (3) to discuss possible factors which may affect the stability of both. The report includes: (1) a review of literature and nomenclature on talus and other natural rubble deposits, (2) descriptions of selected rubble slopes, (3) discussions of various factors affecting the configuration and properties of talus slopes, and (4) evaluation of some factors affecting crater slope stability. TAB

N70-24095# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
TREND SURFACE ANALYSIS AND SPATIAL CORRELATION
Geoffrey S. Watson Sep. 1969 25 p refs
(Contract Nonr-401(09))
(AD-699163; TR-124) Avail: CFSTI CSCL 8/2

The methods for analysing data in one dimension (usually time) are highly developed. However, in several dimensions, most applied workers only use one class of methods -- that in which the data is assumed to be the sum of a deterministic trend and an uncorrelated random error. The more general model with a spatially correlated error has been neglected in most fields -- oceanography is a conspicuous exception. This neglect is partly due to the lack of expositions for the applied workers. However, the manner in which much geological data is now collected does make this application difficult. The aim of this paper is to explain the relevance of the possible models and methods and to indicate their data requirements. An appendix has been added on Matherons work. Author (TAB)

N70-24158# Battelle-Northwest, Richland, Wash. Aeronomy Dept.
[INVESTIGATION OF AURORA AND AIRGLOW] Progress Report
R. J. Hoch Sep. 1969 84 p refs
(Contract AT(45-1)-1830)
(BNWL-1156) Avail: CFSTI

Topics reported on include recent appearances of stable auroral red arcs, spectrographic monitoring of auroral activity at midlatitudes, spectrographic studies, photometric map of the Milky Way, forbidden transitions, nightglow, the F-region ionosphere, automation of aeronomy equipment, and special equipment and facilities development. NSA

N70-24163# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
AURORAL LYMAN-ALPHA OBSERVATIONS
M. A. Clark 25 Oct. 1969 32 p refs
(Contract F04701-69-C-0066)
(AD-699203; TR-0066(5260-10)-2; SAMSO-TR-69-396) Avail: CFSTI CSCL 4/1

Observations have been made of Lyman-alpha auroral emissions during January and February 1967. The observations were made with a narrow-band sky-scanning photometer mounted on an earth-oriented satellite in polar orbit. Auroras in the southern hemisphere were usually single in structure, and those in the north, complex. The single auroral emissions show a typical latitude spread of about 6.5 deg. Intensities up to 60 kR were observed at times of high magnetic activity, implying energy deposition up to 20 ergs/sq cm/sec. The intensities show a correlation with high-latitude geomagnetic activity, with a breakdown during extremely active periods. Author (TAB)

N70-24165# Environmental Research Corp., Alexandria, Va.
AMPLITUDE AND FREQUENCY CHARACTERISTICS OF ELASTIC WAVE TYPES GENERATED BY UNDERGROUND NUCLEAR EXPLOSIONS
W. W. Hays and J. R. Murphy 21 Apr. 1969 60 p refs
(Contract AT(29-2)-1163)
(NVO-1163-181) Avail: CFSTI

Elastic wave types were identified on seismograms recorded from three Pahute Mesa (Boxcar, Stinger, and Rickey) and two Yucca Flat (Zara and Lanpher) detonations utilizing the basic information contained in the seismogram; i.e., the first arrival times and particle motion characteristics. The amplitude characteristics of the identified elastic wave types were determined to vary with yield, source-recording station distance, and frequency. The surface wave and the direct P and S wave modes appear to scale approximately as the first power of yield, whereas refracted and reflected P and S wave modes scale approximately as the 0.6 power. The peak amplitude of body wave window spectra occurs at higher spectral frequencies for the two Tonopah, Nevada stations (especially Tonopah Motel). The frequency of the spectral peak for each wave mode time window shifts slightly from higher to lower values with increase in yield, but is essentially constant with increase in propagation distance over the distance range 22.2 to 79.1 km. Author (NSA)

N70-24167# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
SHORT TERM DENSITY VARIATIONS OVER WHITE SANDS MISSILE RANGE
B. T. Miers and R. O. Olsen Oct. 1969 39 p refs
(AD-699308; ECOM-5275) Avail: CFSTI CSCL 4/1

Two series of atmospheric soundings were made to determine the variation in density over a 4-hour period under nighttime conditions. The series consisted of eight rocketsondes launched at approximately half-hour intervals, with three launched within three minutes of each other to determine instrument reliability. Inflatable falling spheres were launched at the beginning and end of each series to extend the density measurements to an altitude of 92km. Data reduction methods are discussed for bead thermistors and inflatable falling spheres. Author (TAB)

N70-24183# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

ANALYSIS OF LABORATORY TEST DATA TO DERIVE SOIL CONSTITUTIVE PROPERTIES Final Report
John G. Jackson, Jr. Apr. 1969 41 p refs Presented at the DASA Strategic Structures Vulnerability/Hardening Long Range Planning Meeting, Vicksburg, Miss., 14-16 Jan. 1969 Sponsored by DASA /ts AEWES Misc. Paper No. S-69-16
(AD-699326) Avail: CFSTI CSCL 8/13

Computer codes used in the solution of free-field ground shock problems are based on mathematically defined constitutive models. Quantitative input for these constitutive models is primarily based on laboratory test data, but extensive analysis and numerous assumptions are required to convert these data to a form suitable for actual code input. This report presents a detailed illustration of the analyses involved in deriving the soil constitutive properties required for a specific code formulation using laboratory test data from just one stratum of a single site. Data are available from static and dynamic uniaxial strain and triaxial shear tests; code property requirements are for mathematical expressions relating mean pressure to volumetric strain, Poissons ratio to mean pressure, and a plastic yield criterion to mean pressure. The illustration indicates that progress is being made in developing mathematical constitutive models that are realistic in terms of actual physical behavior, but that if many of the assumptions presently being made in soil property analyses are to be eliminated, additional soil tests and measurements must be developed. Author (TAB)

N70-24280# American Science and Engineering Inc., Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE STUDY AND ANALYSIS OF ELECTROSTATIC ANALYZER DATA Final Report, 5 Mar. 1968 -15 Jul. 1969
William P. Reidy 15 Aug. 1969 195 p refs
(Contract F19628-68-C-0287)
(AD-699213; ASE-2255; AFCRL-69-0369) Avail: CFSTI CSCL 4/1

The OV3-2 satellite was instrumented with two electron electrostatic analyzers to measure the auroral electron spectrum between 10 and 100 kev, the electron pitch angle distribution, and the precipitated electron flux. The design and calibration of these instruments are documented. Real time recordings were made at Churchill and Thule. The analysis of this data is presented; including spectral form, spatial distribution, and limited pitch angle distributions. Aerobee rocket 15.735 was instrumented with a high resolution rapid (300 milliseconds per energy sweep) to measure the auroral electron spectrum between 2 and 35 kev and a thin window ionization chamber to measure the total energy deposition. The rocket was launched during the breakup of a visible aurora and penetrated a diffuse auroral region. The energy spectra temporal variation, and the variation in pitch angle distribution as a function of energy are presented. TAB

N70-24324# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
[THERMAL CRACKS IN SEA ICE, CRITICAL RICHARDSON NUMBER AND FRICTIONAL COUPLING BETWEEN AIR AND ICE, AND THE CREEP MECHANISM OF POLYCRYSTALLINE ICE] Annual Report, 1 Oct. 1968 - 30 Sep. 1969
Norbert Untersteiner, Phil Church, Gary Maykut, Roger Evans, and John Kelley 1 Dec. 1969 28 p refs
(Contract N00014-67-A-0103-0007)
(AD-699144; AR-1) Avail: CFSTI CSCL 8/12

Contents: Numerical model of sea ice; Dynamics of sea ice; Thermal cracks in sea ice; Critical Richardson number; Radiation in ice; Ice physics; Atmospheric chemistry; and Micrometeorology. TAB

N70-24358 World Meteorological Organization, Geneva (Switzerland).
SEICHES AND LEVEL DIFFERENCES CAUSED BY WIND IN LAKES, BAYS, SEAS AND ESTUARIES [SEICHES ET DENIVELLATIONS CAUSEES PAR LE VENT DANS LES LACS, BAIES, MERS, ESTUAIRES]
L. J. Tison and G. Tison, Jr. 1969 87 p refs In FRENCH; ENGLISH summary
(MM-246-TP-134; TN-102) Copyright. Avail: Issuing Activity

The phenomena giving rise to seiches have not been studied in detail. Many factors are involved and given seiche may result from several simultaneous effects which may be of a primary or secondary nature. Bay and lake examples are discussed and the following primary causes are mentioned: meteorological (barometric pressure, wind), astronomical, seismic. Secondary causes augment an already existing process of seiche formation and this analysis leads to a distinction between waves of seiches and seiches as such. The importance of a study of the causes, transmission and increase of seiches is stressed. A probability of causes might be established and models may play an important role in such study. On the other hand, the analysis of the hydrodynamics of the seiches is shown to be sufficiently clear and to have been solved with a sufficient degree of accuracy. There is an extensive bibliography arranged by country. Author (ESRO)

N70-24412# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
SOME PHENOMENA IN THE POLAR IONOSPHERE
Lars P. Block Nov. 1969 51 p refs Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 1 - 6 Sep. 1969 (Rept-69-30) Avail: CFSTI

The problems of the polar ionospheric trough, anomalous ion composition at high altitudes, field-aligned electric currents, and acceleration of auroral particles are considered. The polar wind and Mayr's mechanism with diffusion from closed to open field lines may partly explain the trough, the plasmapause, and the anomalous high altitude ion composition. Field-aligned currents may also contribute in this respect. It is shown that acceleration of magnetospheric plasma may lead to very large field-aligned current densities and extended Pedersen currents in the low ionosphere unless there is some current-limiting mechanism. It is proposed that space charge double layers may limit the currents. Some consequences of such double layers are discussed. Author (ESRO)

N70-24610 Virginia Polytechnic Inst., Blacksburg.
INTERPRETATION OF AEROMAGNETIC, MAGNETIC, AND GRAVITY DATA FROM THE SAN FRANCISCO MOUNTAINS VICINITY, SOUTHWESTERN UTAH
James William Schmoker (Ph.D. Thesis) 1969 236 p
Avail: Univ. Microfilms: HC $10.86/Microfilm $3.05 Order No. 69-19984

A three-dimensional model which generates a magnetic field similar to that which is observed is developed, using a digital computer, for the distribution of the magnetic intrusive rocks in the area. Aeromagnetic data are interpreted to indicate a buried Tertiary pluton. The Bouguer gravity anomalies indicate horst and graven structures, and local intrusive cupolas. Three interpretive east-west geologic cross sections reproduce the observed residual gravity anomalies. The regional gravity data are interpreted to how the effect of at least three regional structures which are distinct from the local near-surface structure: An underlying intrusive body, an east-west fault zone bounding the intrusive body on the north, and a continuation of basin and range structure at depths exceeding two miles. Vertical-field ground magnetic data were obtained in selected areas of the Star Range. The contact zone along the southern edge of the Shauntie intrusive body, southeast of the old townsite of Shauntie, is mapped on the basis of magnetic evidence, and four zones of magnetite mineralization between 8 and 25 feet thick are defined. Dissert. Abstr.

N70-24718# Kettelle (John D.) Corp., Arlington, Va.
[THE VALUE OF IMPROVING OCEANOGRAPHIC DATA

PREDICTION BY SATELLITE MEASUREMENTS. VOLUME 1] Final Report
John D. Kettelle 11 Aug. 1969 36 p refs
(Contract N62306-69-C-0099)
(AD-699192; KTR-690-3-69-320-007-Vol-1) Avail: CFSTI CSCL 8/3

The purpose of this study was to determine the value of improving oceanographic data prediction by satellite measurements. The effort was to be carried out in seven tasks, but the specified level of effort was expended before the tasks could be completed, and the study terminated. The tasks and results obtained are summarized, and brief descriptions given of two of the computer simulation models used. Author (TAB)

N70-24716# Kettelle (John D.) Corp., Arlington, Va.
[THE VALUE OF IMPROVING OCEANOGRAPHIC DATA PREDICTION BY SATELLITE MEASUREMENTS, VOLUME 2] Final Report
John D. Kettelle 11 Aug. 1969 114 p refs
(Contract N62306-69-C-0099)
(AD-699193; KTR-690-3-69-320-007-Vol-2) Avail: CFSTI CSCL 8/3

Appendix I of this volume is an evaluation of present and future prediction capability for sea state and sea surface temperature for application to studies under this contract. The limitations on current predictive capability are discussed, and estimates made of the range of errors in wave height predictions as a function of sea state for current and future capabilities. Information is also presented on current and expected future capabilities in sea surface temperature prediction. Appendix II is a description, including a source deck listing, of the ASW Opposed Transit (ASWOT) model. This computer program will simulate transits over specified tracks of single ships or escorted convoys that are opposed by nuclear or conventional submarines. Wave heights and directions are inputted at grid points, and sonar parameters are inputted for defined domains. Author (TAB)

N70-24720# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE PRINCIPLE OF SIMULTANEOUS ADJUSTMENT OF PLANE COORDINATES AND QUASIGEOID HEIGHTS IN AN ASTROGEODETIC NET [O PRINTSIPE SOVMESTNOGO URAVNIVANIYA PLANOVYKH KOORDINAT I VYSOT KVAZIGEOIDA V ASTRONOMO-GEODEZICHESKOI SETI]
V. F. Eremeev et al Nov. 1969 17 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Geod., Aerosemki i Kartografii (Sbornik), no. 176, 1969 p 59–67
(AD-698883; ACIC-TC-1584) Avail: CFSTI CSCL 8/5

A method of simultaneous adjustment of geodetic coordinates and quasigeoid heights is described. It is proposed to alternate the preliminary adjustment of the individual triangulation links with the calculation of quasigeoid heights at the astronomic net stations by means of Molodenskiys formula for astrogravimetric leveling. Author (TAB)

N70-24729# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INFORMATION RELATIVE TO CARTOGRAPHY AND GEODESY. SERIES 1: GERMAN CONTRIBUTIONS AND INFORMATION, NO. 43 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: DEUTSCHE BEITRHEGE UND INFORMATIONEN, HEFT NR. 43]
1969 79 p refs In GERMAN
Avail: CFSTI

The use of densitometric screen printing for map production is described and evaluated. Basic principles of the printing process are outlined for:(1) contact printing of small edition maps for geodetic purposes, photointerpretation, geology, planning, etc; (2) imprinting of additional cartographic information into existing maps; and (3) production of maps and cartographic elements on special printing materials. A multiple color screen printing process reaches color effects of extraordinary brilliancy that are not obtainable by offset printing methods. Transl. by G.G.

N70-24776 World Meteorological Organization, Geneva (Switzerland).
SEA-SURFACE TEMPERATURE Conference Proceedings
1969 182 p refs Mostly in ENGLISH; partly in FRENCH and RUSSIAN; ENGLISH summaries Proc. of the 5th Session of the Comm. for Maritime Meteorol, Geneva, 1968
(WMO-247-TP-135; TN-103) Copyright. Avail: WMO, Geneva: Sw.Fr. 16

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N70-24778 Japan Meteorological Agency, Tokyo. Marine Div.
COLLECTION AND DISSEMINATION OF SEA-SURFACE TEMPERATURE DATA FOR THE NORTH-WEST PACIFIC, AND THEIR UTILIZATION FOR FISHERIES
Ichiro Imai *In* WMO Sea-Surface Temp. 1969 p 19–35 (See N70-24776 11-13)
Copyright. Avail: WMO, Geneva: Sw.Fr. 16

The sources, quantity and quality of marine environmental information available to Japan are described and from this information a ten-day summary of the sea-surface temperature for one-degree squares is prepared. In addition, charts of surface currents, underwater temperatures and other elements are prepared on a monthly basis and disseminated by facsimile. An evaluation of this information has greatly helped to explain the cool summers which occasionally frequent Japan, and other examples show how Japanese fishermen utilize this information for their own special purposes. Author (ESRO)

N70-24779 Bureau of Commercial Fisheries, La Jolla, Fishery-Oceanography Center.
SEA-TEMPERATURE STRUCTURE AND ITS RELATION TO THE UNITED STATES TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN
Glenn A. Flittner *In* WMO Sea-Surface Temp. 1969 p 37–76 refs (See N70-24776 11-13)
Copyright. Avail: WMO, Geneva: Sw. Fr. 16

The United States tuna-fishing industry has problems in locating the fish. Fluctuations in distribution have varied greatly and locating fish concentrations has become a major problem because of the large areas involved. The nature and degree of movement of fish are highly variable from year to year, and these variations can be related to the cycle in the changing pattern of sea-surface

temperature. The vertical structure of the upper sea layers must be known, for when they are relatively cold the fish will not dive and are easily caught. However, when the thermocline is deep, the fish have an environment conducive to escape from the nets used in pursuing operations. There is a close relation between the actual water temperature and where the fish are found, and the fishing industry would benefit greatly from having this kind of sea information placed at its disposal, both observed and forecast. Author (ESRO)

N70-24780 World Meteorological Organization, Geneva (Switzerland).

SST PATTERNS IN THE NORTH-EAST ATLANTIC

J. D. Booth *In its* Sea-Surface Temp. 1969 p 77–96 (See N70-24776 11-13)

Copyright. Avail: WMO, Geneva: Sw. Fr. 16

This paper outlines some of the problems which the British Navy has encountered in the routine synoptic analysis of sea-surface temperature over parts of the north-east Atlantic. Some of the characteristics and pecularities of the SST patterns are discussed, both with regard to persistency and with regard to change. There was good correlation with bottom topography. Author (ESRO)

N70-24781 France. Direction de la Meteorologie Nationale Paris.

TEMPERATURE VARIATIONS OF SEA WATER NEAR THE SURFACE [VARIATIONS DE LA TEMPERATURE DE LA MER AU VOISINAGE DE LA SURFACE]

J. Romer *In* WMO Sea-Surface Temp. 1969 p 97–115 In FRENCH (See N70-24776 11-13)

Copyright. Avail: WMO, Geneva: Sw. Fr. 16

Precise measurements of temperatures in the near surface layer of the sea were carried out at sea where no disturbing effect from coast, ships or platforms was observed; such measurements permit one to assess the value and representativeness, in a synoptic sense, of an observation and to define what is known as sea-surface temperature. The temperature profile in the first five metres was investigated using a thermometer with an accuracy of 0.03 C. The differences in the temperature between 0.1 m and 5 m were obtained from 3,614 observations. The variation of vertical thermal structure with time (diurnal change) and the results of comparison measurements using buckets and thermometers are discussed. Author (ESRO)

N70-24782 World Meteorological Organization, Geneva (Switzerland).

SEA-SURFACE TEMPERATURES: SOME INSTRUMENTS, METHODS AND COMPARISONS

Allan B. Crawford *In its* Sea-Surface Temp. 1969 p 117–129 (See N70-24776 11-13)

Copyright. Avail: WMO, Geneva: Sw. Fr. 16

The ways in which sea-surface temperature may be measured are described and the advantages etc. of the various methods are discussed. The problems involved are complex and the choice of a suitable instrument is dependent upon a number of factors, some of which are completely unrelated. Author (ESRO)

N70-24783 World Meteorological Organization, Geneva (Switzerland).

THE COMPARATIVE MEASUREMENTS OF SEA-SURFACE TEMPERATURE IN THE USSR

G. M. Tauber *In its* Sea-Surface Temp. 1969 p 131–151 refs In ENGLISH and RUSSIAN (See N70-24776 11-13)

Copyright. Avail: WMO, Geneva: Sw. Fr. 16

The technical definition involved in measuring sea-surface temperature is discussed. The paper deals with measurements made in different climate areas (Pacific Ocean and Indian Ocean) and under various ship conditions (drifting or under way). A great variety of instruments were tested, and the paper deals in detail with a comparison of the readings obtained. Author (ESRO)

N70-24795# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 221 2 Feb. 1970 p 56–73 refs (See N70-24792 11-34)

Avail: CFSTI

The discovery of the eastward current under the South Trades Current is discussed. Hydrophysical field study using towed systems is presented, along with a turbulent fluctuation study near sea surface. Low inertia semiconductor and deep water fishing techniques in Poland are described. Abstracts on a wide range of oceanographic data are included. J.A.M.

N70-24796# Joint Publications Research Service, Washington, D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 221 2 Feb. 1970 refs p 74–90 (See N70-24792 11-34)

Avail: CFSTI

The oil drilling rig at Shevchenkovo, a seven kilometer exploratory well, is described. Abstracts on a wide spectrum of geophysical data are included. J.A.M.

N70-24824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN EXPERIMENTAL STUDY OF THE ION CHEMISTRY AND THERMAL BALANCE IN THE E AND F REGION ABOVE WALLOPS ISLAND

M. W. Pharo, III, L. R. Scott, H. G. Mayr, L. H. Brace, and H. A. Taylor, Jr. Dec. 1969 28 p refs Submitted for publication (NASA-TM-X-63877; X-621-69-551) Avail: CFSTI CSCL 04A

Measurements by a Bennett ion mass spectrometer and two electrostatic probes aboard NASA rocket flight 18.06 on August 26, 1966, produced altitude profiles of ion composition and concentration and electron concentration and temperature in the E and F regions above Wallops Island, Virginia. These charged particle measurements, supported by the measurements of N2 concentration and neutral gas temperature (measured twenty minutes earlier by experiments on NASA 18.05), measurements of the extreme ultraviolet spectrum, and the 1964 Jacchia model (for the remaining neutral constituents) serve as a basis for determining reaction rates of the primary chemical reactions responsible for the formation of the ionosphere. Electron temperature measurements and N2 temperatures and concentrations provided rates for electron and ion cooling. The primary thermospheric processes with their reaction rates are shown. The values are comparatively low, but within a factor of three of the values derived in laboratory experiments. The derived cooling rates throughout the entire altitude range were similar to those derived from measurements above Wallops Island in 1960 and 1961 at similar levels of solar activity. Author

N70-24848*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DERIVATION AND TESTS OF THE GODDARD COMBINED GEOPOTENTIAL FIELD (GSFC 1.70-C)

James P. Murphy and James G. Marsh Jan. 1970 18 p refs (NASA-TM-X-63883; X-552-70-104) Avail: CFSTI CSCL 08N

A geopotential field complete to degree and order fifteen has been derived by combining fifteen separate determinations of spherical harmonic coefficients. Among the fields combined were ones obtained from Doppler data, optical data, Doppler and optical data, optical and terrestrial data, optical, Doppler and terrestrial data, and small sets of coefficients obtained by methods of resonant satellite geodesy. Several tests of the combined gravity field were performed. The maximum difference between degree variances obtained from this field and the corresponding ones obtained by Kaula in 1966 from free-air gravity anomalies is 4.5 m gal sq. The corresponding maximum difference obtained with the Smithsonian Astrophysical Observatory (SAO) 1966 Standard Earth was 9.9 m

gal sq. After special resonant coefficients previously determined for the Geodetic Earth Orbiting Satellite (GEOS) I and II were substituted into the combined field, fits to six-day arcs of precisely reduced optical data were made. The rms of the fit to the GEOS I data arc was the best fit among eight published fields considered. For GEOS II, the rms fit was second best among the eight fields. The SAO B13.1 (1969) model was used to obtain a fit for this GEOS II arc. For GEOS orbits 1 sec is approximately equal to 7 m. Some additional improvement to the fits were realized after the resonant coefficients (degree, order) = (13,12) and (13,13) were allowed to adjust. Author

N70-25061# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
OZONE AND HYDROGEN REACTIONS
M. Nicolet 10 Mar. 1970 55 p refs
(Grant NSF GP-5611)
(SR-350) Avail: Issuing Activity

Solar radiation dissociated water vapor into hydrogen atoms and hydroxyl radicals in the thermosphere and upper mesosphere. In the stratosphere and lower mesosphere, dissociation of H2O brought about mainly by a collision process with excited oxygen atoms produced by photodissociation of ozone is reviewed. Such a collision process prevents the existence of normal mixing ratios for methane and molecular hydrogen at the stratopause. The rate of oxidizing processes falling off more rapidly with increase of altitude is discussed. Author

N70-25076# Radio and Space Research Station, Slough (England).
THE USE OF SATELLITE DATA FOR PREDICTION PURPOSES
W. R. Piggott [1969] 17 p refs
Avail: CFSTI

Analyses of satellite data developed at R.S.R.S. for prediction purposes are discussed. Data from the circular orbit satellites, Alouette I and Ariel III are used, the former primarily for delineating rapid changes in foF2 with position, the latter primarily to explore the probable characteristics of the ionosphere in regions where ground based observations are not available. The data disclose some new ionospheric phenomena and can be used to give rules for extrapolating into zones where little or no data are available. Surprisingly large differences are found between the N and S hemisphere at corresponding seasons. An analysis was made of ridges of ionisation and it is shown that the tilts associated with these can enable oblique incidence reflections to follow the ridges as they move about. Equivalent ridges can be computed at the most probable position and used for HF predictions. This makes large differences in the predictions for certain times and zones. The data can also be used to estimate the probable importance of new observing sites. Author

N70-25082# New York Univ., N.Y. Geophysical Science Lab.
MEASUREMENT OF THE STATISTICAL PROPERTIES OF THE OCEAN SURFACE WITH INSTRUMENTED SURFACE FLOATS. PART 2: ENGINEERING AND DATA PROCESSING
Final Summary Report
R. Alfred Saenger Oct. 1969 70 p refs
(Contract N00014-67-A-0647-0012)
(AD-699180; GSL-TR-69-10-Pt-2) Avail: CFSTI CSCL 8/3

Gyro-stabilized vertical accelerometer-roll-pitch-heading floats, special analog processing equipment, a digital recording system, and a group of interconnecting computer processing routines incorporating the fast Fourier transform have been created to measure roughness properties of the ocean surface caused by gravity wave components with frequencies extending up to 1 Hz. The first portion of the report is a summary of the engineering and data processing effort. This is followed by processed surface wave data recorded under nearly stationary statistical conditions during a combined acoustic-oceanographic experiment. A smoothed directional spectrum, probability distributions for surface particle motion in three dimensions, power spectra of wave height and slope, energy flux, and many other examples, are presented. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-23912# California Univ., Berkeley. Lawrence Radiation Lab.
ACCELERATOR PULSED FIELD DOSIMETRY
Paul R. Zurakowski 7 Nov. 1969 24 p refs Presented at the 2d Intern. Conf. on Accelerator Dosimetry and Experience, Stanford, Calif.
(Contract W-7405-eng-48)
(UCRL-71731; CONF-691101-9) Avail: CFSTI

Bremsstrahlung and neutron measurements made with a calorimeter and pulsed neutron detector in pulsed fields varying in energy from 2 to 15 MeV are discussed. Accelerators that were used in the study were 4, 12, 13, and 5 to 15 MeV Linacs. The X-ray measurements, made under electronic equilibrium conditions, were compared with those made with TLD 700 powder and extruded ribbon, a SLAC type RAMS, Victoreen thimble chambers and protable survey equipment with particular emphasis on energy and dose rate dependence. Calorimeter and TLD agreement was excellent. The ionization chambers showed varying degrees of dose rate and energy dependence. The effects of neutrons and beam electrons were also studied. Neutron flux, dose and average energy measurements were in excellent agreement with those found in the literature. An Andersson-Braun type portable neutron instrument was compared with the pulsed neutron detector and found to be somewhat dose rate dependent. Skyshine calculations and measurements are presented for a 13 MeV Linac. The calculations agreed with the measurements to within a factor of 2. Author (NSA)

N70-23952# Akademiya Nauk URSR, Kiev.
ON OBJECTIVE CRITERIA FOR EVALUATING PROPERTIES OF MEASURING DEVICES
V. S. Skryabinskiy *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 10-14 refs In RUSSIAN
(See N70-23951 11-09)
Avail: CFSTI

Criteria for evaluating performance of electrodynamic measuring devices are discussed. The devices treated are assumed to have bearing-supported rotating elements which respond to magnetic moment. Contributions of torque, friction, and rotating moment of inertia are analyzed. It is concluded that the combined effect of electrical and mechanical factors must be considered in order to arrive at optimum design parameters. Transl. by B.E.S.

N70-23953# Akademiya Nauk URSR, Kiev.
EFFECT OF HUMIDITY ON MEASURING ELEMENTS OF AN ELECTROSTATIC SYSTEM
M. S. Veksler (All-Union Sci. Res. Inst. of Electromeasuring Instr.) *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 15-19 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

The effect of ambient humidity on capacitive electrostatic metering devices is investigated. Erroneous response results from changes in dielectric constant and direct condensation of water in the capacitor, which inserts spurious capacitance. These errors can be eliminated in precision instruments by hermetically sealing the

sensing elements; where this is impractical, heaters or desiccators should be locally employed to reduce humidity effects. Transl. by B.E.S.

N70-24012# Dow Chemical Co., Golden, Colo. Rocky Flats Div.

EIGHT UNIT ISOTHERMAL CALORIMETER FOR ROUTINE PLUTONIUM ANALYSES

Robert G. White and Franklin L. Oetting 14 Nov. 1969 9 p refs

(Contract AT(29-1)-1106)

(RFP-1401) Avail: CFSTI

The design and operation of a multiunit isothermal calorimeter, whose primary function is to analyze for plutonium, is described. Although each individual unit is similar in design to the corresponding unit in the twin isothermal calorimeter, the overall design and operation of the multi-unit calorimeter is unique. Author (NSA)

N70-24043# Oak Ridge National Lab., Tenn.

INSTRUMENTATION AND CONTROLS DIVISION Annual Progress Report, for Period Ending 1 Sep. 1969

G. S. Sadowski (comp.) Nov. 1969 154 p refs

(Contract W-7405-eng-26)

(ORNL-4459) Avail: CFSTI

Continuing developments on reactor instrumentation are briefly reported. The main topics discussed are the following: ionizing particle and radiation detectors, radiation monitors, pulse counters, electronic equipment, automatic control and data acquisition, data collection and analysis, process instrumentation and control, instrument maintenance and service, high voltage and linear accelerators, instrumentation and control, in-pile experiment instrumentation, and test loops and loop instrumentation. N.E.N.

N70-24062# Michigan Univ., Ann Arbor. Inst. of Science and Technology.

A PHOTOGRAPHIC STUDY OF APOLLO 9

Wayne Parsons and Joseph Heath Dec. 1969 30 p refs

(Contract DAHC15-68-C-0144)

(AD-698493; Rept-1386-25-T) Avail: CFSTI CSCL 17/8

An experiment was conducted at the Mount Haleakala Observatory to obtain high-quality photographs of the Apollo 9 spacecraft in low earth orbit. Photographs of the Command and Service Module (CSM) and separate photographs of the Lunar Module (LM) were successfully obtained during tracking of Apollo 9 on the mornings of March 12 and 13, 1969. These photographs demonstrate the performance of the high-resolution photographic (HRP) system associated with the 60-in. aperture telescope at this observatory. The acquisition and tracking problems that a fast target such as the Apollo 9 CSM presents, and the solutions to these problems will be of interest to others contemplating a similar effort. This report presents a description of this experiment and an analysis of the results. Author (TAB)

N70-24086# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

A PRECISION EVALUATION OF THE ORTHO-PROJECTOR GIGAS/ZEISS [EINE GENAUIGKEITSUNTERSUCHUNG DES ORTHOPROJEKTORS GAS-ZEISS]

Hermann G. Neubauer 1969 76 p refs In GERMAN *Its* Ser. No. 1

(Rept-42) Avail: CFSTI

Optical precision of the ortho-projector Gigas in reestablishing serial strip photographs was evaluated by analyzing the following error sources: (1) operation error; (2) error in the surveying model; error connection between stereo-planigraph and ortho projector; (3) instrument error of ortho projector; (4) observer error; and (5) film error in ortho photos. It was shown that blurring increased proportional to depth of focus. Transl. by G.G.

N70-24120# California Univ., Los Angeles. School of Engineering and Applied Sciences.

PICOSECOND WAVEFORM INSTRUMENTATION STUDY Final Technical Report, 10 Aug. 1967 – 31 Jul. 1969

Robert C. Mackey Nov. 1969 359 p refs

(Contract F30602-68-C-0001)

(AD-698340; UCLA-69-34; RADC-TR-69-317) Avail: CFSTI CSCL 14/2

The report contains the results of a two year picosecond risetime instrumentation feasibility study. The problems involved in such instrumentation were carefully investigated. The system evolved from the preliminary efforts consisting of: an electro-optic probe which modulates a laser beam; a photocathode-electrostatic deflection CRT which produces a spiral trace on the CRT screen; and a photographic-microdensitometer readout. Although many problems must be solved before a practical picosecond waveform instrument can be produced, the feasibility of such an instrument has been demonstrated. In addition to general engineering considerations, basic research in high frequency electro-optic materials, and studies of low transit time electrostatic deflection methods are included in this report. Author (TAB)

N70-24158# National Bureau of Standards, Washington, D.C. Electronic Technology Div.

METHODS OF MEASUREMENT FOR SEMICONDUCTOR MATERIALS, PROCESS CONTROL, AND DEVICES Quarterly Report, 1 Jul. – 30 Sep. 1969

W. Murray Bullis, ed. Mar. 1970 71 p refs

(NBS-TN-520) Avail: SOD $0.65

The development of methods of measurement for semiconductor materials, process control, and devices is presented. Principal emphasis is placed on measurement of resistivity, carrier lifetime, and electrical inhomogeneities in semiconductor crystals; evaluation of wire bonds; and measurement of thermal properties of semiconductor devices. Author

N70-24164# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

A ROSS FILTER SYSTEM FOR MEASURING X-RAY SPECTRA IN Z-PINCH PLASMA FOCUS DEVICES Technical Report, Jul. 1967 – Jul. 1968

H. L. L. van Paassen 1 Jul. 1969 19 p refs

(Contract F04701-69-C-0066)

(AD-699202; TR-0066(5220-50)-6; SAMSO-TR-69-395) Avail: CFSTI CSCL 18/4

The development of plasma pinch and other flash x-ray devices has created the need for a system capable of measuring the spectra of 50 nsec x-ray pulses. A Ross filter system that measured both the integrated and time resolved x-ray spectra from several plasma pinch devices is described. Filters made from readily available materials were used in conjunction with both film and solid state detectors to measure x-ray spectra between 5.46 and 115.6 keV. Author (TAB)

N70-24220# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

TECHNICAL DATA PACKAGE FOR ROCKET-BORNE OZONESONDE

J. S. Randhawa Oct. 1969 99 p refs

(AD-699310; ECOM-5278) Avail: CFSTI CSCL 4/1

The design and performance requirements are described for a transistorized, 1680 MHz rocket-borne ozonesonde capable of measuring ozone concentration from 65 km to 10 km. Engineering sketches for the ozonesonde and power supply are included as part of this data package. Author (TAB)

N70-24232# General Motors Corp., Kokomo, Ind. Delco Radio Div.

INTEGRATED FIRE AND OVERHEAT DETECTION SYSTEM FOR AIRCRAFT Technical Report, 15 Nov. 1968 - 15 Sep. 1969

B. J. Raskauskas Dec. 1969 77 p

(Contract F33615-69-C-1196)

(AD-699210; AFAPL-TR-69-97) Avail: CFSTI CSCL 13/12

The object of the program was to design and build an operational fire and overheat detection system, which used continuous sensors, PIN sensors, silicon solar cell sensors, and silicon carbide sensors for manned flight vehicles. The system consists of sensitizing modules, detection circuits and logic circuits. Operational capability ranges from -55C to +125C. The system is designed to drive a readout with four separate notations, FIRE, OVERHEAT, FAIL and OK. Author (TAB)

N70-24246*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SOME PHOTOGRAPHIC RESULTS OF THE APOLLO 11 MISSION

Paul A. Larsen 27 Feb. 1970 91 p refs

(NASA-TM-X-64501) Avail: CFSTI CSCL 14E

The work reported was done for several reasons: (1) to show what types of photographs are available as a result of the Apollo 11 mission; (2) to give the best possible photographic description of the lunar terrain in the vicinity of Tranquillity Base, and as many other areas of the lunar surface as possible, so that Lunar Roving Vehicle (LRV) mission planners, designers, and engineers can obtain a feel for several types of lunar terrain that may be encountered by the lunar roving vehicle; (3) to show some of the better pictures as single photographs, stereograms, constructed panoramic views, sequence strips, and mosaics; (4) to demonstrate the feasibility of making certain elevation measurements of lunar topographical features, by using lunar photographs, photogrammetric techniques, and locally available photogrammetric equipment; and (5) to provide a reminder of the value of high altitude earth photography for earth resources studies. The 1405 photographs taken during the Apollo 11 mission were reviewed. Of this number, 104 were judged to be of sufficient interest for this study, and to warrant further analysis. Consequently, 27 stereograms, 9 panoramic views, one sequence strip, one mosaic, and 17 single photographs are included in this report, together with pertinent interpretations of the photographic data. Author

N70-24255# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INSTRUMENT FOR MEASURING NONSTATIONARY THERMAL DEFORMATIONS OF OBJECTS IN A GAS FLOW

M. D. Bodrova et al 3 Oct. 1969 11 p Transl. into ENGLISH from the publ. "Mashiny i Pribory dlya Ispytaniya Metallov i Plastmass" Moscow, Mashgiz., 1965 p 8-11

(AD-699222; FTD-MT-24-181-69) Avail: CFSTI CSCL 20/11

A special device allowing the recording and measurement of deformations in an unstable gas stream is described. The device is based on an optical scheme, with an electric spark illumination of the data units and recording of their shifts on photographic film. The gas flows through the inner part of a double-walled cylinder. The outer wall of the cylinder forms an air jacket for temperature control. The optical system used to detect and record deformations is described. Special attachments used in the system include an OT 24-51 oscillograph, a KR-1 induction coil, an MKU-48 electromagnetic relay, and BPVL wiring 1 mm in diameter. A wiring diagram for the device is shown. The report presents a graph illustrating the time variation of deformation of the cylinder wall and temperatures recorded in the test layer during heating and cooling. Author (TAB)

N70-24286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH-SPEED ELECTRON BEAM ELECTROGRAPHY: AN ADVANCED METHOD OF INFORMATION DOCUMENTATION

M. G. Reynberg 25 Jul. 1969 15 p refs Transl. into ENGLISH from Pribory i Sistemy Upr. (Moscow), no. 4, 1968 p 57-59

(AD-699122; FTD-MT-24-175-69) Avail: CFSTI CSCL 14/5

The report describes the developing of a videograph recording and printing electron beam tube with a metal fiber screen for nondestructive test instrumentation, high-speed computer printout, and high-speed facsimile equipment. The tube is called Unikon-55. One version included in a system has an anode and a cathode with a 20-kv negative potential. Author (TAB)

N70-24298# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.

LECTURES ON ELECTRON MICROSCOPY, PART 1 [APPUNTI DI MICROSCOPIA ELETTRONICA, PART 1]

D. Steve Bocciarelli 15 May 1969 60 p In ITALIAN; ENGLISH summary

(ISS-69/19) Avail: CFSTI

Chromatic, spherical and diffractive defects, distortion, field curvature, and astigmatism in electron lenses are discussed. Imaging techniques in traditional and electron microscopes are described, including calibration, and measurement by the electron microscope. Photographic and autoradiographic processes are also described. Transl. by F.O.S.

N70-24313*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N.Y. Power Conversion Dept.

MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE Final Report, Aug. 1966 - Sep. 1969

Gerald Levy, Leon Zadoff, and Martin Begun Sep. 1969 95 p refs

(Contract NAS8-20663)

(NASA-CR-102471; PCD-TR-69-6; FHR-3287-3) Avail: CFSTI CSCL 14B

The development is described of an experimental laboratory model of an electric field meter using the electron beam deflection technique and the development of a glow discharge test chamber within which laboratory testing of this meter in an ionized environment was accomplished. Author

N70-24339*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ANALYTIC DETERMINATION OF CAMERA OPERABILITY STATUS CONSIDERING DYNAMIC SOLAR CONFLICT FOR THE RADIO ASTRONOMY EXPLORER SATELLITE

Harvey Walden Washington Apr. 1970 17 p refs

(NASA-TN-D-5665; G-955) Avail: CFSTI CSCL 14E

An analytic method is formulated capable of predicting times unsuitable for useful vidicon camera operation for the Radio Astronomy Explorer satellite due to solar inclusion within the cameras' conical fields of view. The vidicons, mounted within the central hub of the gravity-gradient-stabilized spacecraft, measure the 750-foot cruciform antenna boom tip positions. A computational algorithm is developed which calculates, for each time point, the angle between the sun line referenced to the spacecraft hub center and the camera field of view axis for each of the two upper boom vidicons directed toward the galactic sphere. The analysis leading to the prediction of the camera operability status includes the effects of the skewed libration damper rod but does not consider possible dynamic attitude coupling with antenna boom flexural deformations. Numerical results from the computational algorithm show that the sun line-camera axis angles display regular oscillatory variations with approximately the same period as that of the satellite orbital anomalistic period. Over the course of many orbital periods, the camera operability constant-status time intervals change markedly due to the slowly-varying shift in the sun line orientation relative to the satellite orbital plane. Author

N70-24379# Naval Research Lab., Washington, D.C.
A MATERIALS AND DEFECT SIMULATOR FOR CALIBRATING ULTRASONIC EQUIPMENT USED IN NONDESTRUCTIVE TESTING OR INSPECTION Interim Report
Henry H. Chaskelis Dec. 1969 15 p
(AD-699149; NRL-6984) Avail: CFSTI CSCL 14/2

An ultrasonic Electronic Test Block (ETB) has been devised for use in calibrating ultrasonic nondestructive tests and equipment. The ETB is similar to a transponder. A device sensitive to ultrasonic waves receives the acoustic signal emitted by any ultrasonic equipment. This received signal is then electronically processed and re-emitted in such manner as to appear to be an echo, as from a standard reference block. Both vertical and horizontal linearity on the cathode-ray-tube screen as well as resolution can be determined at the testing site, rather than in the laboratory as is presently necessary using standard reference blocks. The use of the ETB as a flaw size simulator is being further investigated; this use is feasible if the ETB can be used to measure the active area and the operating frequency of the acoustic signal, since the echo characteristics depend not only on the flaw parameters but also on the acoustic signal parameters. Author (TAB)

N70-24475# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF NEUTRON SPECTROMETRY FOR CRITICAL FACILITIES Quarterly Report, 1 Jul. –30 Sep. 1969
R. A. Semmler Dec. 1969 25 p ref
(Contract AT(11-1)-578)
(IITRI-578-P-33-12; QR-4) Avail: CFSTI

Calibration and testing of a wall-less proportional counter for neutron spectrometry in the 1 to 100 keV energy region using the proton recoil technique were completed during this quarter. The counter and all associated electronics were transported to Argonne National Laboratory for testing in a fast flux environment. The tests in both thermal and fast neutron fluxes were generally successful. A survey of the results is given. Recommendations for changes in the test procedures to improve the low energy response are outlined. Also recommended are modifications to be incorporated into a new detector assembly to reduce the likelihood of electrical breakdown problems. Author (NSA)

N70-24522# Sylvania Electronic Systems-East, Waltham, Mass. Applied Research Lab.
RANGE SENSOR TECHNIQUES FOR AUTOMATIC OBJECT IDENTIFICATION Final Report, 7 Oct. 1968 –6 Nov. 1969
George A. Biernson, Raymond Euling, and William S. Jamagin Nov. 1969 151 p refs
(Contract F19628-69-C-0071)
(AD-698349; F-8100-1; AFCRL-69-0503) Avail: CFSTI CSCL 17/8

Automatic object identification can be greatly augmented if the sensor provides direct incremental range (or depth) data of the object. The report investigates feasible range sensor designs for this application. A number of practical optical range sensor designs that could operate in bright sunlight are presented and analyzed quantitatively. A design is also presented of an experimental model for laboratory use, which could be used to explore the potentialities of range sensing for automatic object identification. Author (TAB)

N70-24523# New Hampshire Univ., Durham. Antenna Systems Lab.
COORDINATE CONVERSION TECHNIQUES FOR USE WITH A CORRELATION RADIO INTERFEROMETER
Ronald R. Clark and Albert D. Frost 15 Jul. 1969 27 p refs
Its Scientific No. 2
(Contract AF 19(628)-5837)
(AD-688344; ASL-69-A; AFCRL-69-0414) Avail: CFSTI CSCL 3/2

The radio interferometer can be operated in a quadrature mode such that information on both signal amplitude and phase can be obtained in terms of orthogonal coordinates X and Y. Techniques for the conversion of this data to polar coordinates are reported and the design of a servo-computer presently used in the UNH/AFCRL radio interferometer is described in detail. Author (TAB)

N70-24537# Instituto de Energia Atomica, Sao Paulo (Brazil).
CONSTRUCTION AND OPERATION OF A PROPORTIONAL GAS FLOW COUNTER
Maria Jose C. Nastasi and Alcidio Abrao Feb. 1968 16 p refs Presented at the 18th Ann. Meeting of the Brazilian Soc. for the Prog. of Sci., Blumenau, Brazil, 10–16 Jul. 1966
(IEA-157; CONF-660732-1) Avail: CFSTI

The construction and operation of a proportional gas flow counter for alpha and beta counting are described. Studies were made with the purpose of using domestic kitchen gas (LPG) as the counting gas. In order to extend the detector's life, special emphasis has been given to the chemical treatment of the gas. This counter is in routine work using the LPG as counting gas and exhibits very good plateaus for alpha and beta counting. The duration of the detector has been largely increased due to the convenient chemical treatment of the gas. Author (NSA)

N70-24600# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
VACUUM-LOCK ACTUATOR AND ION-SOURCE POSITIONER FOR A SURFACE IONIZATION MASS SPECTROMETER
Olin H. Howard, Aubrey Langdon, and Fred W. Taylor 4 Aug. 1969 10 p refs
(Contract W-7405-eng-26)
(K-1776) Avail: CFSTI

A vacuum-lock actuator and an ion-source positioner were designed, fabricated, and installed on a surface ionization mass spectrometer to eliminate stressing of the analyzer tube, which impairs its alignment. The electrically powered vacuum-lock actuator also eliminates the manual effort formerly required to operate the vacuum lock. Author (NSA)

N70-24620# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A PROGRAM TO ACQUIRE ENVIRONMENTAL FIELD DATA IN FOUR AREAS IN A HUMID SUBTROPIC ENVIRONMENT Final Report, 1 May 1968 –31 Aug. 1969
John E. Walker Nov. 1969 168 p refs
(Contract F19628-68-C0339)
(AD-698345; CAL-VT-2636-O-1; AFCRL-69-0393) Avail: CFSTI CSCL 8/6

Multiband remote sensing provides a means of obtaining signatures for natural earth objects and backgrounds. Data were collected from four humid tropical environments in Puerto Rico. Irradiance spectral reflectance, surface temperature, soil moisture, soil granularity, air temperature, humidity, wind speed and direction measurements and ground photographs were obtained. The limited analysis resulted in the development of bi band methodology for determining whether variations in film image density of soil is caused by surface moisture or surface structure. It is concluded that an electro-optical multiband analysis system using bi band techniques can be developed to facilitate the task of terrain analysis and at the same time provide the tools necessary to extend the utility of multiband remote sensing to obtain spectral signatures for other earth objects and backgrounds. TAB

N70-24648 Polytechnic Inst. of Brooklyn, N.Y.
DETECTION IN THE SONAR ENVIRONMENT
Lowell W. Bauer (Ph.D. Thesis) 1969 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-20315

To cope with the problems of detection in a sonar environment, a number of processors which can adapt to, or are insensitive to, different kinds of interference and medium effects are investigated. The problem of time and frequency spreading of signals by the medium is minimized through a judicious choice of transmitted waveforms, while simplified models are used to describe and analyze the effect of various components of interference that might be encountered. The operating characteristics of a number of "reasonable" processors are compared under various conditions that are suitable approximations to those that might be encountered in an actual detection situation. An extensive set of performance curves has been included to facilitate comparisons between different detectors. Of particular interest are analyses of the median normalizer, the nonparametric coincidence detector, and the normalizing-and-quantizing detector. Dissert. Abstr.

N70-24713# France. Ministere de l'Air, Paris
DEVELOPMENT OF A GONIOMETRIC DEVICE AND THE OBSERVATION OF BROADBAND WAVEFORMS IN THE WAVELENGTH DOMAIN [ETUDE ET REALISATION D'UN DISPOSITIF DE GONIOMETRIE ET D'OBSERVATION DE FORMES D'ONDE, EN LARGE BANDE, DANS LE DOMAINE DES ONDES LONGUES]
Jacques Bertin 1969 77 p refs In FRENCH
(NT-171) Avail: CFSTI

A logarithmic amplification system associated with a system of functional uncertainty in broadband waveforms in the partly very low frequencies of the Hertzian spectra is presented. This system allows for the goniometry of atmospheric discharges and the recording of waveforms. Observations are made of wave directions and interval distances of reflective signals. Transl. by J.M.C.

N70-24736# United Kingdom Atomic Energy Authority, Harwell (England).
AN INVESTIGATION OF METHODS OF TIME SCANNING A SINGLE-CHANNEL PULSE AMPLITUDE SELECTOR
H. A. Cole Oct. 1969 12 p refs
(AERE-M-2249) Avail: CFSTI

Experimental results are given for the use of a recently designed pulse amplitude selector (Harwell 2000-Series Type 2252) operated in various modes of spectrum scanning, and whose channel width and channel position are controlled by an external analog voltage. Author (NSA)

N70-24761# Sandia Corp., Albuquerque, N.Mex.
TOLERANCE COMPARATOR
P. A. Nicovich Nov. 1969 10 p Sponsored by AEC
(SC-R-112-A) Avail: CFSTI

The fabrication of machine parts with circular features begins with engineering drawings on which the tolerances are conventionally designated in terms of a diameter. Actual production of the part is accomplished by machining operations and inspection measurements usually made coordinately along mutually perpendicular planes or axis. A comparator device, or visual slide calculator, designed to permit quick and accurate comparisons of bilateral tolerances and coordinate measurements with position tolerance diameters is described with instructions on its use. The device is included with the report. NSA

N70-24798*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ACCURACY OF THE HIGH RESOLUTION INFRARED RADIOMETER ON NIMBUS 2
E. J. Williamson Washington Apr. 1970 18 p refs
(NASA-TN-D-5551) Avail: CFSTI CSCL 14B

The technique for reducing High Resolution Infrared Radiometer (HRIR) data is examined, and the sources of error in the results are discussed. It is found that random errors caused by noise, and systematic errors caused by the analytical techniques used, become so large at temperatures below 240 K that some of the results may be meaningless. A procedure is proposed that should help to reduce some of these errors. Author

N70-24803*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
COMPUTERIZED MICROSTRAIN TEST SYSTEM
J. W. Lyons, H. C. Pambookian, J. P. Krawiec, and T. P. Curran Washington Apr. 1970 21 p refs
(NASA-TM-X-1990; C-110) Avail: CFSTI CSCL 14B

A computerized microstrain measuring system is described. The system utilizes an automatic absolute capacitance measuring bridge with either an analog or hybrid computer to measure plastic deformation, hysteresis loop areas, and total strain energy at microinch sensitivities over a 7500 microinch strain range in conventional load-unload tensile tests. Details of the system, including computer simulation, calibration, and error sources, are discussed. Microyield, elastic limit, specific damping energy, and internal friction results obtained with 52100 steel, 6061-T6 aluminum, and 6AL-4V titanium alloys are presented. Examples of additional capabilities are mentioned. Author

N70-24828# Beloit Coll., Wis.
X-RAY TELESCOPE OPTICS
D. J. Schroeder *In* Univ. Coll., London Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 14–27 refs (See N70-24826 11-30)
Avail: CFSTI

A brief review of the principles and basic design criteria of X-ray imaging systems, optical properties of various types of grazing incidence telescopes, and problem areas encountered in working toward optimum performance is submitted. There is no attempt to give an exhaustive analysis of any of these topics, but rather the various alternatives open to consideration are presented. Possibilities for a large cosmic X-ray telescope, both actual and proposed designs are also presented. Author (ESRO)

N70-24829# Smithsonian Astrophysical Observatory, Cambridge, Mass.
X-RAY DETECTORS FOR GALACTIC ASTRONOMY FROM SATELLITES
Robert J. Davis *In* Univ. Coll., London Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 28–34 refs (See N70-24826 11-30)
Avail: CFSTI

A brief introduction to the subject of X-ray detectors for use in satellites is given. The detectors discussed are photographic film, scintillation, geiger and proportional counters and photomultiplier tubes. Background rejection techniques are outlined. ESRO

N70-24830# University Coll., London (England). Mullard Space Science Lab.
CALIBRATION OF X-RAY PHOTOMULTIPLIERS
A. F. Timothy and J. G. Timothy *In its* Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 35–43 refs (See N70-24826 11-30)
Avail: CFSTI

Open-structure photomultipliers can withstand the shock of satellite launchings and operate in a vacuum environment and so are more advantageous than conventional gas-filled X-ray detectors. Open-structure photomultipliers and methods of calibration for determining photon fluxes from X-ray sources are described. Photomultiplier efficiencies and the stability of response are also discussed. ESRO

N70-24838# United Kingdom Atomic Energy Authority, Harwell (England).
CALIBRATION JIG FOR SURFACE CONTAMINATION MONITORS

J. Stephenson and G. S. Bruce Oct. 1969 8 p refs
(AERE-M-2201) Avail: CFSTI

The construction of a simple jig for the testing and calibration of alpha and beta/gamma surface contamination monitors is described. Author (NSA)

N70-24852*# General Electric Co., Philadelphia, Pa. Missiles and Space Div.

IMAGE MEDIA INVESTIGATION FOR HOLOGRAPHIC STAR FIELD MAPPER

J. D. Welch Jan. 1970 69 p refs
(Contract NAS12-2148)
(NASA-CR-86336) Avail: CFSTI CSCL 14E

This investigation was concerned exclusively with one aspect of the application of coherent optical data processing techniques to real time star field recognition and tracking: the specification and selection of an input imaging medium on which to record the candidate star field which is to be recognized and tracked by a holographic star field mapper. A practical technique is sought for storing a large number of star field patterns in some type of multiple filter so that a spatial frequency representation of any part of the celestial sphere can be readily accessible. Also evaluated for this space application is a capability of exposing the medium to the star field image, developing the exposed medium, and using the recorded image in such a way as to preserve the relative position and orientation data of the star field. The evaluation of various media was made on a best effort basis based on available data. Author

N70-24913# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Science and Technology Div.

SERVICE GUIDE FOR CA-78 AND CA-77 OSCILLOSCOPE CAMERAS, TECHNICAL MANUAL

P. Wurlitzer 11 Jun. 1969 71 p
(EGG-1183-505; B-4036) Avail: CFSTI

The oscilloscope cameras, types CA 78 and 77, were developed to replace the type 850, 3171, and LC-4 cameras as manufacturing models. Modular features were included in the cameras to allow flexible operation and the use of interchangeable units. Polaroid pack and sheet film packs were used interchangeably. An optional camera format was modified to allow the use of 35mm film and framing magazines. A main record area 38mm square with an adjacent visual data chamber presentation or an optional 25mm square area with an adjacent data chamber image were included in the film format. Author

N70-24963*# Hamilton Standard, Windsor Locks, Conn.

INSTRUMENTATION AND CONTROL

In its Trade-Off Study and Conceptual Designs of Regenerative Advanced Integrated Life Support Systems Jan. 1970 p 519-571
(See N70-24951 11-05)
Avail: CFSTI HC$10.00/MF$0.65 CSCL 14B

The instrumentation and control subsystem (ICS) consists of the necessary sensors and instruments, with appropriate signal conditioning and controls, to provide the capability of controlling, monitoring, and locating and analyzing problems in the EC/LS system during any mode of operation. Author

N70-25059# National Aviation Facilities Experimental Center, Atlantic City, N.J.

CRITERIA FOR AIRCRAFT INSTALLATION AND UTILIZATION OF AN EXTINGUISHING AGENT CONCENTRATION RECORDER Final Report, 1967-1970

George Chamberlain Mar. 1970 74 p
(FAA-DS-70-3; FAA-NA-70-17) Avail: CFSTI

The specialized test equipment, provides criteria for the installation and operation of this equipment, and provides the guidelines for utilization of the equipment for the conduct of meaningful test programs are described. The extinguishing agent concentration recorder, as specialized gas analyzer test equipment, and its operational principle are considered. Guidelines are presented for the location and installation of extinguishing agent concentration sampling probes within the test article. The value and recognition of the utilization of the gas analyzer test equipment as the most effective means of determining the performance of an aircraft extinguishing system are also discussed. Author

N70-25094# Joint Publications Research Service, Washington, D.C.

SENSITIVE ELEMENTS AND SENSORS USED ON SPACECRAFT FOR SCIENTIFIC MISSIONS [CHUVSTVITELNYYE ELEMENTY I DATCHIKI, ISPOLZUYEMYYE NA KOSMICHESKIKH APPARATAKH NAUCHNOGO NAZNACHENIYA]

A. V. Liventsov 20 Mar. 1970 19 p refs Transl. into ENGLISH of Space Res. Inst., USSR Acad. Sci. conf. paper Presented at the 20th IAF Congr., Moscow, 1969
(JPRS-50113) Avail: CFSTI

An investigation of the requirements imposed on the sensitive elements and sensors used in the orientation systems of spacecraft designed for scientific research is presented. Sensitive elements are classified with respect to purpose and the corresponding groups of requirements on them, and the requirements on the sensitive elements in the near future are also defined. Some schemes for sensitive elements which satisfy operating conditions in sets of scientific equipment designed for studying outer space and also methods and procedures insuring that characteristics of the sensitive elements will be obtained as required for scientific research are investigated. Some means of further improvement of sensitive elements and sensors are noted. Author

N70-25109# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

A TECHNIQUE FOR MEASURING, RECORDING AND ANALYZING TORSIONAL OSCILLATIONS OF CRANKSHAFTS OF RECIPROCATING ENGINES

T. H. Hammell and J. E. Carvish Jun. 1969 20 p refs
(NRC-11149; ME-232) Avail: CFSTI

Tests were made on three types of transducers. A variable capacitor unit that frequency modulates a carrier wave was considered best for general use. The inherently good signal-to-noise ratio, plus the ability to calibrate statically in the field, were considered particularly attractive. It was found that dynamic calibration of the transducer should be carried out periodically, and a good Hookes couple is ideal for this purpose. Several instrumentation check methods are outlined that may be followed to assure consistency in the data produced. Author

N70-25130# Space Disturbances Lab., Boulder, Colo.

A TWO-CHANNEL PHOTOMETER FOR USE IN SMALL SOUNDING ROCKETS

J. C. Haslett and L. R. Megill Jan. 1970 23 p refs
(ESSA-TR-ERL-88-SDL-4) Avail: SOD $0.30

Four photometers were flown successfully to study the diurnal variation of the O2 (1 Delta g) concentration by measuring 1.27 micron radiation from the (1 Delta g to 3 Sigma g(-)) transition. The performance was satisfactory and comparable to similar instruments. A small photometer with optics suitable for small detectors including photomultipliers was developed with the light baffling system being particularly good. The optics, electronics, and mechanical considerations are discussed, with a few sources of difficulty being pointed out. The laboratory and field calibration procedures which were followed are described. Author

N70-25142# Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.

THE MANUFACTURE OF Ge(Li) DETECTORS

A. S. M. DeJesus 1969 15 p refs
(CSIR-283) Avail: CFSTI

Ge(Li) detectors have been manufactured at the National Physical Research Laboratory using both the planar and coaxial configurations. The manufacturing procedure and characteristics of the detectors are given. Problems associated with the base material and other problems encountered during the various phases of manufacture are discussed. The elimination of the need for a reetch when transferring a detector from one cryostat to another is also described. Author (NSA)

N70-25148*# Kollsman Instrument Corp., Syosset, N.Y.
APOLLO OPTICAL SUBSYSTEM AND LM ALIGNMENT OPTICAL TELESCOPE. VOLUME 1: PROGRAM SUMMARY Final Report
Feb. 1970 23 p Prepared for Gen. Motors Corp.
(Contract NAS9-497)
(NASA-CR-108358) Avail: CFSTI CSCL 17H

Brief descriptions are given of an optical unit assembly, alignment optical telescope, map and data viewer, Apollo rangefinder, and ground support equipment. The organizational breakdown in the program to develop the above equipment is summarized. J.M.C.

N70-25149*# Kollsman Instrument Corp., Syosset, N.Y. General Motors Corp., Milwaukee, Wis.
APOLLO OPTICAL SUBSYSTEM AND LM ALIGNMENT OPTICAL TELESCOPE, VOLUME 2, REPORT
Feb. 1970 498 p refs Prepared for Gen. Motors Corp.
(Contract NAS9-497)
(NASA-CR-108359) Avail: CFSTI CSCL 17H

The management aspects of a project to develop and produce optical equipment for the Apollo Project and Lunar Landing Module are discussed. Specific areas of management, technical, engineering, reliability, quality control, documentation, and field operations are presented. The effectiveness of project management techniques is reflected in the one million dollar underrun which was achieved. P.N.F

N70-25150*# Kollsman Instrument Corp., Syosset, N.Y. General Motors Corp., Milwaukee, Wis.
APOLLO OPTICAL SUBSYSTEM AND LM ALIGNMENT OPTICAL TELESCOPE, VOLUME 2, PART 2 Final Report
Feb. 1970 408 p Prepared for Gen. Motors Corp., Milwaukee
(Contract NAS9-497)
(NASA-CR-108360) Avail: CFSTI CSCL 17H

The functions of an Apollo Reliability group concerned with the manufacture of optical equipment for the Apollo spacecraft and Lunar Module are described. The group assured the reliability of the product by establishing standards of workmanship, techniques of manufacture, techniques and standards for measurement of achieved reliability, and by indoctrinating personnel with reliability concepts and reliability consciousness. A reliability program was established to determine reliability requirements through reliability analyses, environmental analyses, design review, test planning, and selection of parts and materials for the Apollo optical subsystem. Author

N70-25182# Akademiya Nauk URSR, Kiev.
ERRORS IN MEASURING THE INDUCTION OF MAGNETICALLY HARD MATERIALS WHEN THE MEASURING DEVICES ARE PLACED IN THE GAPS OF POLE TERMINALS
S. T. Usatenko and N. Ye. Fevraleva *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 152–157 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

An analysis of the measurement errors is presented. The relative error for measuring induction in a noncommutative device consists of three basic components: the errors from the breakdown of the proportionality between the current in the test specimen and in the air gap in which the induction meter is placed; the errors of the method of measurement; and the errors connected with the necessity of accounting for the cross section of the specimen. Transl. by H.W

N70-25184# Akademiya Nauk URSR, Kiev.
A COERCIVE FORCE METER FOR MAGNETICALLY HARD MATERIALS WITH A MEASUREMENT LIMIT OF 150 KA/M
Ye. A. Andriyevskiy and Ya. F. Nepokrytyy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 165–171 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A device is described for measuring the coercive force according to the magnetization of specimens made from both magnetically hard materials and simple permanent magnets with coercive force of up to 150 ka/m. The error of measurement of this device is 3% for simple shapes and about 3 to 5% for more complex designs. Transl. by H.W.

N70-25185# Akademiya Nauk URSR, Kiev.
MEASURING BLOCK OF A DEVICE FOR TESTING MAGNETICALLY HARD MATERIALS
Ye. B. Ivanov and S. T. Usatenko *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 172–177 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

A device is described which is used to test magnetically hard materials with direct reading of measured values for induction and magnetic field intensity and energy. The device is free of certain defects found in units which use pulse induction methods. The units can produce measurements within allowable margins of error faster than pulse induction devices. It has limited applicability because of the high requirements for specimen preparation. Transl. by H.W.

N70-25186# Akademiya Nauk URSR, Kiev.
PHOTOELECTRIC MEASURING SYSTEMS WITH SCANNING CONVERSION
P. P. Ornatskiy, B. Ya. Brusilovskiy, and V. Yu. Meshcherskiy *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 178–186 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

When it is necessary to make automatic remote measurements using optical systems, there arises the problem of converting the distance between marks in the field of vision into an electrical value. To realize this conversion some sort of photoelectrical indicator device is needed which will provide an electrical pulse when the image of the mark falls on it. A circuit is described and its operation analyzed for a remote control photoelectric measuring system with scanning conversion. Very often the photoanalyzing system of optical devices with visual readout is made in the form of scanning converters. An analysis of the precision is presented for such devices. Transl. by H.W.

N70-25197 University Coll. of Swansea (Wales). Dept. of Physics.
NEW DEVELOPMENTS IN ELECTRONIC POSITION DETECTORS
C. Grey Morgan *In* CERN Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 123–160 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

Methods and systems of position detectors for high energy electron and proton beams are discussed. Spark and streamer chambers, and electronic methods of examining bubble chamber film records are also covered. Grid profile monitors and probe beam scanners for secondary electron emissions are described. Position detectors based on residual gas ionization, strip electrodes, and phosphor screens are reviewed, along with gas ionization beam

scanners. Details are given on track detection employing electrical discharges in gases and inductive beam position monitors. The possibility of using laser radiation to detect particles is considered. N.E.N.

N70-25198 European Organization for Nuclear Research, Geneva (Switzerland).
EVOLUTION OF SOME PARTICLE DETECTORS BASED ON THE DISCHARGE IN GASES
G. Charpak *In its* Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 161–180 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

The properties are summarized of some detectors which are commonly used in counter experiments to localize charged particles and are based on discharge in gases under the influence of electric fields. The field distribution around wire electrodes and the electric field effects on free electrons in a gas are discussed. Gaseous amplification in the uniform region of streamer and spark chambers, and the region of avalanche multiplication are described. Automatic spark chambers used in large high energy laboratories include wire chambers with core read-out, with magnetostrictive read-out, and in magnetic fields. Details are given on the limits of amplification, spatial resolution, time resolution, and operational problems of multiwire proportional chambers. N.E.N.

N70-25199 European Organization for Nuclear Research, Geneva (Switzerland).
THE OMEGA PROJECT
A. Michelini *In its* Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 181–206 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

The large spectrometer magnet, its characteristics, and high energy interaction results are described. The magnet is used with a detector system operating inside the field volume and a data acquisition system based on two on-line computers. The useful magnetic field of 18 kG extends over a volume of 3 m diameter by 2 m height. Schemes of the magnet, optical spark chambers, and test coil are given, and typical event data are graphed. Configurations for studying different reactions are indicated. N.E.N.

N70-25202*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETOMETERS FOR SPACE RESEARCH
Norman F. Ness (Citta Univ., Rome) Mar. 1970 186 p refs
(NASA-TM-X-63887; X-690-70-78) Avail: CFSTI CSCL 14B

This paper presents a review of those spacecraft instruments which have provided measurements of the magnetic fields of the earth, moon, Mars, Venus and interplanetary measurements of the extended solar field obtained near the ecliptic between the orbits of Mars and Venus. A chronological summary of spacecraft to be discussed is presented in the form of a bar graph extending throughout the data lifetime of the magnetometer experiments. A total of 51 separate or paired spacecraft launches have occurred since 1958, each instrumented with one or more magnetometers. Discussed are the fundamental principles of operation of the different types of magnetometers which have been developed for space flight, and their operation on the two types of attitude stabilized spacecraft, fixed and spinning. Aspects of these devices as sources of magnetic field data and the subsequent processing of this data to obtain unique information are given. A discussion of the most frequently used coordinate systems and the properties of vector field averages follows. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-23910# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
EFFECT OF MACHINING VARIABLES ON TOOL TEMPERATURES
Clarence A. Pippin 21 Nov. 1969 32 p refs
(Contract AT(29-1)-1106)
(RFP-1409) Avail: CFSTI

The effect of machining variables on tool temperatures was studied in order to obtain the temperature distribution patterns at the tool tip. Four distances (depths) below the top surface of the tool bit were investigated, and results were tabulated. The depths of cut were varied between 0.005 and 0.040 inches and the feed rates ranged from 0.0021 to 0.0167 inches per revolution. The cutting speed was maintained at approximately 400 feet per minute. Surface temperatures were determined by extrapolation from the four depths experimentally investigated. The maximum tool-surface temperature was 614 F, at a 0.040-inch depth of cut and a feed of 0.0167 inches per revolution. The experimental work was done on Type-6061T6 aluminum which was easy to use. It is expected that such work will be useful as soon as random determinations can be made on plutonium. Author (NSA)

N70-23983# Battelle-Northwest, Richland, Wash.
ELECTRO-THERMAL NONDESTRUCTIVE TESTING METHOD
D. R. Green and L. C. McCullough Dec. 1969 7 p
(Contract AT(45-1)-1830)
(BNWL-1273) Avail: CFSTI

A nondestructive testing technique capable of detecting flaws in metals has been developed. This technique uses electrical heating in conjunction with infrared mapping of surface temperatures. It has been demonstrated on steel bars having 1/16 in. diameter holes drilled at a depth of approximately 0.146 in. under the surface. Author (NSA)

N70-23990# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
BETTER VACUUM FOR BETTER PARTS
Richard S. Culver and George Herbst 24 Sep. 1969 10 p
(Contract AT(29-1)-1106)
(RFP-1353) Avail: CFSTI

The results obtained during explosive forming into a die when both inadequate and adequate vacuums are used are described. A mathematical analysis of phenomena observed using inadequate vacuums is presented. Details of vacuum system design and operation as well as practical aspects of vacuum measurement as applied to explosive forming are given. Author (NSA)

N70-24019# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
SOVIET TECHNOLOGY ON THERMAL MECHANICAL TREATMENT OF METALS
S. Dunleavy and J. W. Spretnak 15 Nov. 1969 33 p refs
(Contract F33615-69-C-1343)
(AD-698754; DMIC-Memo-244) Avail: CFSTI CSCL 11/6

One of the most promising methods for strengthening metallic materials that has evolved in the past 15 years is the process of thermal mechanical treatment (TMT). This process, which involves plastic deformation at elevated temperatures and retention of the worked structured at ambient temperature is unique--increases in strength may be attained with a gain or little loss is ductility. There are, of course, definite problems associated with the process such

as the degree of temperature control required in plant operations and the negation of the TMT effect in welding processes. This report reviews the trend of Soviet efforts. Author (TAB)

N70-24024# Army Foreign Science and Technology Center, Washington, D.C.

STUDY OF THE RESERVES FOR INCREASING EFFICIENCY IN THE PRESSURE-PROCESSING OF HEAT-RESISTANT STEELS OF THE MARTENSITE AND MARTENSITE-AUSTENITE CLASSES [IZYSKANIE REZERVOV POVYSHENIYA TEKHNOLOGICHNOSTI PRI OBRABOTKE DAVLENIEM TEPLOUS TOICHIVYKH STALEI MARTENTSITNOGO I MARTENTSITO-AUSTENITNOGO KLASSOV]

N. S. Alferova et al 7 Jan. 1970 11 p refs Transl. into ENGLISH from Strukt. i Sroistra Lharoprochnykh Metallicheskikh Materialov, (Moscow), 1967

(AD-699109; FSTC-HT-23-422-70) Avail: CFSTI CSCL 13/8

The report concerns the problem of investigating the reserve for increasing efficiency and effectiveness in pressure-processing of high-strength steels which are difficult to deform. In performing this work a study was made of the possibility of improving the deformability of steels of the martensite and martensite-austenitic classes by proper selection of a rational regime for softening thermal processing, the use of warm rolling and rolling in a state of supercooled austenite. The test materials were high-strength heat-resistant EP56 and EP451 steels. The investigations revealed definite possibilities for improving the effectiveness and efficiency of steels of the martensite and martensite-austenitic classes, hardened by alloying and difficult to deform, by means of deformation in a state of supercooled austenite (low-temperature thermomechanical processing method). In addition to these advantages in the process of steel deformation in a state of supercooled austenite, the method precludes special inter-operation temperings. Author (TAB)

N70-24083# Army Materials and Mechanics Research Center, Watertown, Mass.

MECHANICAL TESTING: THE CHARPY 5-NOTCH IMPACT TEST

1 Dec. 1969 72 p refs

(AD-699377; AMXMR-P-702-104) Avail: CFSTI CSCL 14/2

The document discusses the Charpy V-notch impact test. Described is the purpose and theory of the test, the design and calibration of the testing machine, specimen fabrication, testing procedures, and the variables which will affect test accuracy and reproducibility. Author (TAB)

N70-24187# Columbia Univ., New York. Lubrication Research Lab.

DESIGN GUIDE FOR HYDROSTATIC AXISYMMETRIC COMPLIANT-SURFACE THRUST BEARINGS Technical Report

V. Castelli, G. K. Rightmire, M. K. Benjamin, and D. D. Fuller Nov. 1969 71 p refs

(Contract Nonr-4259(06))

(AD-699184; TR-16) Avail: CFSTI CSCL 13/9

The design guide presents parameters for a hydrostatic circular thrust bearing with an elastomer-coated surface. Use of the design charts is illustrated by eight examples. Recess pressure, displacement, lubricant flow, and bearing stiffness are the design parameters of particular interest. TAB

N70-24216# Argonne National Lab., Ill.

SOME OBSERVATIONS ON PHENOMENA AFFECTING WEAR OF BEARING MATERIALS IN SLIDING CONTACT IN SODIUM AND ARGON AT TEMPERATURES UP TO 1200 F

E. S. Sowa, K. C. Tsao, C. Fiala, and C. J. Divona Jul. 1969 24 p refs

(Contract W-31-109-eng-38) (ANL-7580) Avail: CFSTI

Vee blocks of bearing materials such as Type 304 stainless steel, Clarite T-1, Stellite 19B, and molybdenum, were installed in a modified Falex machine and loaded against Carboloy 78B shafts rotated at 20 rpm for 2-hr periods in static sodium and argon at 300, 500, 700, 900, and 1200 F, respectively. Use of Carboloy shafts restricted wear to the vee blocks. A generalized equation was developed and simplified in an attempt to establish a parametric relationship of the variables affecting the relative wear of these materials. Variations in values of the wear coefficient and a constant reflected the interactions between the vee block-shaft assemblies and the test environments. Retention of MoO3 as molybdate for molybdenum in sodium results in marked improvement in wear resistance over identical specimens in argon. Recordings of drive-motor current input superimposed above wear plots of Type 304 and Stellite 19B show a correlation between time variation in friction coefficient in regions of abnormal wear and a more stable value in regions of normal wear. Author (NSA)

N70-24229# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.

WEAR REACTIONS OCCURRING AT THE INTERFACES OF MECHANICAL FACE SEALS IN THE BOUNDARY LUBRICATION CONDITION

David Keith Matthes (M.S. Thesis) Dec. 1969 77 p refs

(Contract N00014-68-A-1044)

(AD-699509; ME69-T57-7) Avail: CFSTI CSCL 11/1

The study of mechanical seal interfacial wear was made using dry nitrogen gas as the sealed fluid and both industrially pure nickel and some nickel-chromium alloys were used as seal ring materials. The experimentally produced wear reactions were studied metallurgically using optical and electron microscopy. For optical investigations, each seal ring was cut at an angle of five degrees to the worn surface in order to elongate the wear impressions. Surface replicas and chemically thinned sections were produced for electron microscopic studies. The data gathered for detailed investigation were photomicrographs of selected wear areas. Stereographic pairs of most wear areas were taken to aid in documenting the surface irregularities observed, by producing a three dimensional effect to the viewer. Photomicrographs of the thin films were taken to make possible the study of the sub-structure of the material immediately below the wear track. Author (TAB)

N70-24258*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN STUDY OF SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION. PART 1: SELF-ACTING PAD GEOMETRY

John Zuk, Lawrence P. Ludwig, and Robert L. Johnson Washington Apr. 1970 39 p refs

(NASA-TN-D-5744; E-5453) Avail: CFSTI CSCL 11A

The load capacity of several self-acting pad geometries was calculated for various pad recess depths, film thicknesses, and angular deformations. The study revealed that the self-acting pad geometry had a high gas film stiffness. This high gas film stiffness is inherently suited for seal operation since the lift force drops off rapidly if the seal tends to open; hence, the seal will not remain open at a large film thickness, which would allow high leakage. Also, this high gas film stiffness forces the seal nosepiece to dynamically track the face runout of the rotor. The load capacity calculations showed that the self-acting pad geometry can accommodate practical face deformations. Author

N70-24290# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.

RESTORATION OF OPTICAL PROPERTIES OF SURFACES BY RADIOFREQUENCY EXCITED OXYGEN

John R. Hollahan, George L. Carlson, and Roger B. Gillette Nov. 1969 18 p refs

(AD-699087; D1-82-0935) Avail: CFSTI CSCL 20/6

Surfaces of mirrors or other optical devices employed in satellite programs will in time become contaminated with thin layers of polymer films. These films originate most likely from outgassing and polymerization by u.v. radiation with condensation on critical optical surfaces. The contaminant films degrade the reflectivity of mirrors and the performance of critical optical surfaces. Atomic oxygen from a high-frequency plasma restores optical surfaces to their original properties by rapid non-contaminating, non-destructive oxidation of the polymer film. Author (TAB)

N70-24311*# Astro-Space Labs., Inc., Huntsville, Ala. M and E Lab.
DESIGN DOCUMENTATION AND TEST HARDWARE FOR AN ENGINEERING MODEL OF A SERPENTUATOR Final Report
J. R. Loyd, III [1969] 44 p
(Contract NAS8-30166)
(NASA-CR-102597; ASL-FR68-8) Avail: CFSTI CSCL 13I

The Serpentuator is an engineering model of controllable, mechanical linkage to be used to determine the feasibility of using such a device for: 1) Material handling with the Orbital Workshop, and, 2) as an extension of the forty (40) foot ATM Serpentuator to locate tip sensors for inspection of the exterior of the OWS cluster, or to position earth looking or cluster looking experiments. Design, fabrication, and testing of the model is reported. Author

N70-24469# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
THE EFFECT OF ULTRAHIGH VACUUM ON THE FRICTION BETWEEN VARIOUS SOLIDS AND GRANULAR SOILS
L. L. Karafieth and G. Mohr Mar. 1970 38 p refs
(RE-376) Avail: CFSTI

The initial and kinetic friction developing in ultrahigh vacuum between various solids and ground basalt was measured in an apparatus designed for this purpose. The solid materials used in the ultrahigh vacuum tests were titanium and fiberglass; the particle size range of the ground basalt was 250–500 mu. The results of these and the earlier experiments with steel showed that the total frictional resistance between the various solids and soils tested invariably increases in ultrahigh vacuum but in a different way for the various combinations of materials. The kinetic friction for steel on basalt increased by a constant adhesion, while for both titanium and fiberglass the coefficient of kinetic friction increased appreciably while the adhesion decreased slightly. The increase in the initial friction was significant for fiberglass and steel and negligible for titanium. The use of the experimental relationships between normal stress and frictional resistance for the computation of traction that wheels can exert is discussed. Author

N70-24703# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
IMPROVED PROCESSING PROCEDURES FOR HEAT-TREATABLE DUAL-HARDNESS STEEL ARMOR Final Technical Report, 4 Sep. 1968 – 4 Sep. 1969
Samuel J. Mangello 29 Dec. 1969 91 p refs
(Contract DAAG46-69-C-0003)
(AD-699419; AMMRC-CR-69-19) Avail: CFSTI CSCL 19/4

Because of various processing difficulties and a high rejection rate encountered in the early commercialization of heat-treatable dual-hardness steel armor, extensive studies were made to solve these problems. The process-technology study describes work culminating in the minimization of decarburization, elimination of surface grinding, cutting of plates without edge cracking, and elimination of quench cracking. Author (TAB)

N70-24717# ARO, Inc., Arnold Air Force Station, Tenn.
REVIEW ON THE VACUUM PUMPING OF HYDROGEN Final Report, Oct. 1968–Jan. 1969
J. D. Haygood, D. M. Treyer, and R. F. Brown AEDC Dec. 1969 68 p refs
(Contract F40600-69-C-0001)
(AD-698324; AEDC-TR-69-109) Avail: CFSTI CSCL 13/11

This report summarizes the findings of an investigation into various possible methods of pumping hydrogen (H2). The objective was primarily to find methods which might prove useful for pumping rocket plumes. A secondary objective was to select H2 pumping methods for other types of tests. The methods reported include mechanical pumping, diffusion pumping, gettering, cryosorption, chemisorption, and cryopumping. Cryosorption pumping is judged to show the most promise as a pumping method for rocket plume testing, although most of the other methods will be found useful where the pumping speed requirements are less demanding. Author (TAB)

N70-24727 Virginia Polytechnic Inst., Blacksburg.
PREDICTION OF THE RUNNING TORQUE OF INSTRUMENT BALL BEARINGS AT HIGH SPEED UNDER COMBINED RADIAL AND AXIAL LOADS
George Edward Clarke, III (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-12667

An expression to represent the torque versus speed behavior of instrument ball bearings between 1000 and 40,000 rpm with various combinations of radial and axial load ranging between 0 and 200 grams is presented. Because of the lack of experimental data for instrument bearings over any range of speeds, loads and sizes, it was necessary to construct a suitable bearing tester and accumulate the required data. The driving source was a small air turbine which performed smoothly and reliably between 0 and 50,000 rpm. The torque measuring system employed strain gages on a very small beam which was used to sense forces on the stationary outer race of the bearing while the inner race was driven at speed. Each test was conducted from 0 to 40,000 rpm. Dissert. Abstr.

N70-24759# Max-Planck-Institut fur Physik und Atrosphysik, Munich (West Germany). Inst. fuer Extraterrestrische Physik.
ELASTIC PAYLOAD SUSPENSION WITH BIG INTERNAL DAMPING, DEMONSTRATED WITH A JAVELIN PAYLOAD [ELASTISCHE NUTZLASTAUFHAENGUNG MIT GROSSER INNERER DAEMPFUNG, GEZEIGT AM BEISPIEL EINER JAVELIN-NUTZLAST]
J. Stoecker 1969 17 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

After an explanation of the physical aspects of damped oscillatory systems, an example is given of damping a Javelin rocket payload with viscoelastic materials as the spring bodies maximum permissible vibration acceleration on certain experiments was about 20 g. It is shown that the control of vibrations on a rocket payload by means of elastic bearings raises some problems. There is no unique solution for every case although the correct application of viscoelastic spring bodies can give very useful results. ESRO

N70-24839# Naval Research Lab., Washington, D.C.
DYNAMIC TEAR ENERGY: A PRACTICAL PERFORMANCE CRITERION FOR FRACTURE RESISTANCE Final Report
E. A. Lange and F. J. Loss 17 Nov. 1969 23 p refs
(AD-699143; NRL-6975) Avail: CFSTI CSCL 11/6

The Dynamic Tear (DT) method of testing for fracture toughness was developed to overcome the limitations of the Charpy V (C sub v) test and to provide information of engineering design significance. Key features of the DT test are described, including specimen design, impact test machines, and methods of energy measurement. A relationship exists between the DT energy and the fracture mechanics stress-intensity factor K sub Ic which allows the translation of these energy values into design parameters, such as critical flaw size and stress level, by means of suitable charts. The

current need for the use of the DT test in the development and selection of high-strength structural metals has become evident through examples of conditions to which the C sub v test has been shown to be inadequate. For example, when fracture toughness criteria defined by the C sub v and DT tests are compared for a high-strength titanium alloy, a 180-ksi yield strength steel, a 140-ksi yield strength steel weld metal, and a Q and T 2-1/4% Cr - 1% Mo steel of 90-ksi yield strength, the C sub v test is shown to provide information in variance to that from the DT, DWT-NDT, and Robertson tests. Therefore, it is concluded that the DT test method has desirable features for general industrial use which provide broad-scope characterization of the fracture resistance of steels, titanium alloys, and aluminum alloys. Author (TAB)

N70-24888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEED AND AUGER STUDIES OF EFFECT OF OXYGEN ON ADHESION OF CLEAN IRON (001) AND (011) SURFACES
Donald H. Buckley Washington Apr. 1970 18 p refs
(NASA-TN-D-5756; E-5509) Avail: CFSTI CSCL 11F

Adhesion experiments were conducted with the (001) and (011) surfaces of iron. A 3.0-mm-diameter flat contacted a larger crystal surface at forces from negligible load to 350 dynes. With the presence of even fractions of monolayer of oxygen, adhesion of iron to itself decreased appreciably. Adhesion decreased with increasing surface coverage. The minimum in adhesion was observed with a full FeO layer formed on the (001) surface of iron. A comparison of adhesion data with oxygen on the surface and that with hydrogen sulfide indicates that for, equivalent surface coverages, the relative effectiveness of the absorbed species in reducing adhesion may be related to the percent surface coverage. Author

N70-25110# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
COATING OF FISSILE PARTICLES BY HF INDUCTIVE PLASMA SPUTTERING [REVETEMENT DE PARTICULES FISSILES PAR PULVERISATION PAR PLASMA INDUCTIF HAUTE FREQUENCE]
P. Beucherie and M. Block 1969 10 p refs In FRENCH
(EUR-4398.F) Avail: CFSTI

HF inductive plasma sputtering is shown to constitute an interesting new method for coating loosely packed pieces of small dimensions, such as small spherical particles of fissile material with diameters of the order of 1 mm as used in certain types of nuclear reactors. A description is given of the experimental rig and the working conditions used for obtaining uniform surface coatings of such particles. Author

N70-25125# California Univ., Livermore. Lawrence Radiation Lab.
STATISTICAL DIMENSION CONTROL OF A LATHE [LE CONTROLE DIMENSIONNEL STATISTIQUE D'UN TOUR]
J. Plas 1969 32 p refs Transl. into ENGLISH from CIRP, Ann. Int. Prod. Eng. Res. (French), v. 17, 1969 8 p Sponsored by AEC
(UCRL-Trans-10410) Avail: CFSTI

The automatic compensation of systematic dimensional errors is the only means for optimizing the statistical behavior of an automatic lathe. The optimization of a system designed for this purpose is described. The theory, which makes use of computer simulation, is discussed, and experimental and theoretical results are compared. Author (NSA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-24145# Pasadena Foundation for Medical Research, Calif. Dept. of Laser Biology.
THE EFFECT OF LASER ENERGY ON CELLS IN TISSUE CULTURE Annual Summary Report
Donald E. Rounds 3 Dec. 1969 21 p refs
(Contract DA-49-193-MD-2564)
(AD-699383; ASR-2) Avail: CFSTI CSCL 6/18

Laser power at 2650 A produced cytolysis and inhibition in the migration of leukocytes. It also inhibited the activity of lactic dehydrogenase, and produced a photoproduct of uridylic acid with a reversible absorption change. Injured cells showed a loss of mitotic activity and an increased frequency of nuclear abnormalities. The focused argon microbeam produced visible lesions in nucleoli which showed a reduced uridine incorporation into RNA. Ablation of the nucleolar organizer sites on chromosomes showed a loss of genetic function in organizing a nucleolus. Concentrations of 0.0001 to 0.01 M ADP could mimic the promotion of blood clotting rates, platelet agglutination, and inhibition of cell growth, which were produced by chemicals that are released from ruby laser-traumatized cells. Author (TAB)

N70-24221# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
REAL TIME LASER PROPAGATION DATA ANALYSIS TECHNIQUE
K. O. White and S. A. Schleusener Oct. 1969 31 p refs
(AD-699309; ECOM-5277) Avail: CFSTI CSCL 20/6

A new technique for real time analysis and display of pulsed laser propagation data is described and initial test results of the method are presented. The technique centers around the use of a dual parameter, pulse-height analyzer to record and display data in a rectangular X-Y field. The display gives a real time visual indication of the quality of the test results. It is shown that the emission from long pulse ruby and erbium lasers can be analyzed and displayed in the proposed manner. Author (TAB)

N70-24237# Oregon Graduate Center for Study and Research, Portland.
MULTIWAVELENGTH LASER PROPAGATION STUDY, 2 Quarterly Progress Report, 15 Sep. – 15 Dec. 1969
J. Richard Kerr Oct. 1970 46 p refs
(Contract N00014-68-A-0461; ARPA Order-306)
(AD-699498; Rept-1154-6; QPR-2) Avail: CFSTI CSCL 20/6

In conducting multiwavelength scintillation experiments over a one mile path, it was found that a finite-sized transmitter aperture does not represent a true spherical-wave source, regardless of the beam divergence used. This observation has important implications for the interpretation of other data on the saturation of scintillations, and in the present experiments has lead to the redesign of the transmitter to achieve a virtual point source. This has been completed, including a provision for independently increasing the aperture at each wavelength up to two inches in diameter, for later transmitter-aperture-dependence measurements. A highly-developed thermal probe system for the detailed study of turbulence structure was made completely operational, and a portable laser system was fabricated for independent optical turbulence strength measurements. All subsystems of the experimental facility are operating without problems, and no further modifications are contemplated. In order to put the problem of atmospheric scintillations in current perspective and to guide the comprehensive experiments, a discussion of recent experimental and theoretical issues is given. Author (TAB)

N70-24284*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A LASER VELOCITY MEASUREMENT SYSTEM FOR HIGH-TEMPERATURE WIND TUNNELS
George R. Grant and Ralph W. Donaldson Washington Apr. 1970 8 p refs
(NASA-TM-X-1976; A-3406) Avail: CFSTI CSCL 20E

Traditional low velocity measurement techniques of using probes inserted into the flow are cumbersome in high velocity, high enthalpy gas flow facilities because the probes disturb the flow and deteriorate rapidly. A laser probe utilizing the Doppler shift of scattered laser light is shown to be suitable for this purpose. Velocities of Mach 2.8 were measured in a small cold flow nozzle made especially for this purpose. Insufficient heterodyne signal eventually limits the highest velocities that can be measured by this method, but in the present experiment the highest velocity measured was limited only by the maximum practical flow rate of the cold flow nozzle. The measurements were obtained by (1) the use of a high power argon laser, (2) the addition of finely divided TiO_2 and NH_4Cl to the stream, and (3) careful design of the detector system to assure superposition of the direct and the scattered beam at the photocathode. This superposition was accomplished by means of an image transfer system which focused the entrance aperture of the detector system on the photocathode, and had the additional advantage of allowing for the insertion of a 4880 A filter in a parallel part of the transfer system optics. Simultaneous pitot probe measurements of stream velocity agreed well. Author

N70-24292# Joint Publications Research Service, Washington, D.C.
LASER RADARS
V. I. Petrovskiy et al 23 Mar. 1970 75 p refs Transl. into ENGLISH of the book "Lokatory Na Lazerakh" Moscow, Publishing House of the Ministry of Defense, 12 Feb. 1969 p 1–104
(JPRS-50123) Avail: CFSTI

The use of optical wavelengths instead of radio waves in radars makes it possible to considerably raise the accuracy of determining the range and angular coordinates of targets. The operating principles of the basic elements of optical radars are explained and possible ways of developing new optical radar systems are considered. Author

N70-24420 Georgia Inst. of Tech., Atlanta.
LASER DOPPLER FLOWMETERS: A SPECTRAL ANALYSIS
William Taylor Mayo, Jr. (Ph.D. Thesis) 1969 239 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-19792

The objectives were to provide theoretical insight concerning the effects of the optical subsystem of an optical heterodyne laser Doppler flowmeter on the measurement volume dimensions, the system alignment, the signal bandwidth, and the signal-to-noise ratio; to design improved laser flowmeter optical systems; to experimentally verify the feasibility of improved systems, and to verify some of the predicted variations of signal bandwidth and signal-to-noise ratio. A general static model of the laser flowmeter was formulated from which the signal current could be determined in terms of the positions of the scatterers. The flow velocity was assumed constant in space and time to isolate signal spectral effects dependent on the optical system from those dependent on the flow field. A three dimensional Poisson shot-noise random process was developed and used to formulate a stochastic model of the flowmeter signal current. The feasibility of the flowmeter optical systems was demonstrated. Dissert. Abstr.

N70-24499# Naval Research Lab., Washington, D.C.
LASER RADAR RANGE EQUATION CONSIDERATIONS
Final Report
F. W. Wyman 11 Dec. 1969 39 p refs
(AD-699519; NRL-6971) Avail: CFSTI CSCL 17/8

Starting with basic physical and beam-target-geometry concepts, a generalized laser radar range equation is derived which holds for a target at any range in the far field. For completeness, the reflective properties of a target, its cross section, and the one-way atmospheric transmission loss are examined. The relationships derived in this report are general in that they are valid at any (e.g., microwave) wavelengths. Author (TAB)

N70-24614 Polytechnic Inst. of Brooklyn N.Y.
LASER RESONATOR MODES IN MOVING AND INHOMOGENEOUS HOST MEDIA
Chang Hwi Chi (Ph.D. Thesis) 1969 183 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20323

In the solution of resonance modes in the laser cavity a technique of solution is developed which gives rather simple analytical expressions for the eigenvalues of lowest even and odd modes. For the case of resonance modes with inhomogeneous host medium a set of eigenfunctions is obtained which clearly exhibit the undulatory behavior of beam diameter and phase front and these eigenfunctions approach the eigenfunctions of homogeneous medium as the inhomogeneity approaches zero. When the host medium is homogeneous and moving with a constant speed the results show that the beam shape and diffraction loss are the same as those of homogeneous and stationary host medium but the resonant frequencies are shifted from those of stationary host medium. When the inhomogeneity and Fresnel number are small an equivalent cavity system can be formed in which the host medium is homogeneous and the geometry is given by an equivalent Fresnel number. Diffraction losses and resonant frequencies and beam shape are given for all cases of resonator host media. Dissert. Abstr.

N70-24640# Eidgenossische Technische Hochschule, Zurich (Switzerland).
RESONATOR INTERFEROMETRY OF PULSED SUBMILLIMETER WAVE LASERS
Hans Steffen (Ph.D. Thesis) 1968 52 p refs *Its* Dissertation No. 4209
Avail: CFSTI

Laser resonator interferometry for submillimeterwave lasers is discussed. In particular it shows its application to the study of various aspects of the laser emission. The basis of the interferometry is an understanding of the resonator mode structure, which is derived from a theory of resonators with low Fresnel numbers and dielectric enclosure. The mode structure is confirmed by experimental results. Interferometric studies reveal a relation between the mode structure and the shape of the laser output pulses. This allows some conclusions with respect to the molecular mechanism which is responsible for laser emission. Author

N70-24927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF A BEAM OF LIGHT ON THE DISLOCATION STRUCTURE
T. M. Averyanova et al 15 Sep. 1969 15 p refs Transl. into ENGLISH from Zh. Prikl. Mekhani. Tekhn. Fiz. (USSR), no. 1, 1966 p 79–82
(AD-699119; FTD-HT-23-369-68) Avail: CFSTI CSCL 20/2

This is a sequel to earlier work by the authors where it was shown that a laser beam incident on a metallic surface produces a crater, the hardness around which is several times higher than the hardness that can be obtained in the same material by any of the known mechanical or heat-treatment hardening methods. As hardness is connected with the dislocation structure, the authors have investigated the changes produced by a laser beam in the dislocation structure of high-purity NaCl, on the surface of which the emergence of the dislocations can be readily displayed. Individual experiments were also carried out on single crystals of refractory tantalum metal. A ruby laser operating in the multiple-spike mode was used. The laser and the apparatus used to measure its beam intensity are described. Author (TAB)

N70-24941 Polytechnic Inst. of Brooklyn, N.Y.
AN INFORMATION FEEDBACK TECHNIQUE APPLIED TO LASER DIGITAL COMMUNICATIONS SYSTEMS
Larry U. Dworkin (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20328

The use of predecision feedback in a laser communication system employing an amplitude or polarization modulated laser transmitter and photomultiplier receiver is considered. Poisson statistics are used to describe the distribution of emitted photo electrons in a fixed time interval from the photo emissive surface of the receiver when the incident field is a mixture of a single mode laser and broadband thermal noise. The use of a noiseless feedback path to reduce the variance of the received photo electron count is examined. A technique known as feedback averaging is conceived and the following properties are demonstrated: (1) The variance of the received photo electron counts is significantly reduced over that obtained in a system without feedback; (2) The effects of background radiation and shot noise at the receiver can be reduced; and (3) The effects of slow fading on the mean arrival rate of photons is reduced. Dissert. Abstr.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-23940# Brown Univ., Providence, R.I. Div. of Engineering.
MICROSTRUCTURAL ASPECTS OF THE STRENGTH AND HARDNESS OF CEMENTED TUNGSTEN CARBIDE
J. Gurland Dec. 1969 26 p refs
(Contract ARPA SD-86)
(AD-699187; ARPA-E70) Avail: CFSTI CSCL 13/9

The balance of hardness and strength in sintered tungsten carbide-cobalt alloys is obtained by adjusting cobalt content and particle size of WC. The variations of hardness and strength with composition and particle size are discussed in terms of the mechanical interaction of the hard and ductile phases. The observed increase of hardness and yield strength with decreasing cobalt content and decreasing particle size is attributed to the plastic constraint of the cobalt layers in contact with the tungsten carbide. The plastic constraint also causes a transition between ductile and brittle modes of fracture, which, in turn, accounts for the observed maximum of fracture strength at small values of the carbide spacing. The theories of fracture pertaining to compositions of commercial alloys are based on the Griffith-Orowan equation, the parameters of which have been empirically related to the microstructure. Further progress in the design of WC-Co alloys can be achieved by control of the microstructure and the potential improvement of mechanical properties obtainable by the control of a number of variables is briefly mentioned. Author (TAB)

N70-24008*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-TEMPERATURE X-RAY-DIFFRACTOMETER STUDY OF OXIDATION OF TWO SUPERALLOYS, WI-52 AND IN-100
Carl E. Lowell and Isadore L. Dreil Washington Apr. 1970 21 p refs
(NASA-TM-X-2002; E-5230) Avail: CFSTI CSCL 11F

Oxidation of the cobalt alloy WI-52 and the nickel alloy IN-100 in air for 100 hr was studied by high-temperature X-ray diffraction. Polished WI-52 at 1600 to 2000 F (1144 to 1366 K) initially formed oxide scales of predominantly CoO, followed by $CoCr_2O_4$ formation. Ground and lapped WI-52 initially formed Cr_2O_3, followed by rapid CoO and $CoCr_2O_4$ formation. At 1900 F (1311 K) the scale of IN-100 after 100 hr had $NiTiO_3$ and $NiAl_2O_4$ as major phases; at 1700 and 1500 F (1200 and 1089 K) NiO was the major phase. Author

N70-24058# Aerospace Corp., El Segundo, Calif. Materials Science Lab.
MECHANICAL PROPERTIES OF NITRIDED AUSTENITIC STAINLESS STEEL AS RELATED TO MICROSTRUCTURE, 1 JANUARY – 1 JULY 1969
James K. Stanley 3 Nov. 1969 41 p refs
(Contract F04701-69-C-0066)
(AD-698745; TR-0066(5250-10)-8; SAMSO-TR-69-372) Avail: CFSTI CSCL 11/6

In studies concerned with the deterioration of high temperature materials, four austenitic stainless steels (AISI Types 304, 316, 321, and 347) were nitrided in ammonia for 72 hours at 425C (800F), 540C (1000F), 650C (1200F), 785C (1450F), and 980C (1800F). Tube tensile specimens, nitrided on both the outside and inside diameters, were tested. A nitride case formed on the steels nitrided at 650C (1200F) and higher. Tensile specimens of Type 321 (titanium stabilized) disintegrated during the 540C (1000F) exposure. Ductility, as measured by elongation, was severely reduced at all temperatures of nitriding, whether a case formed or not. Yield strength significantly increased except for the 425C (1800F) treatment where it decreased. Ultimate strength was reduced at all temperatures, but was recovered at 980C (1800F) with all of the steels except Type 321 (titanium stabilized). In many instances, the load-extrusion curves beyond the yield point were very irregular as the nitride case cracked with increasing load. Changes in these mechanical properties were difficult to correlate to the nitrided area. Properties were affected even if no case formed. The nitride case in all four stainless steels was found by X-ray diffraction to consist of (Fe,Cr)N and alpha-iron (martensite). Author (TAB)

N70-24089# Argonne National Lab., Ill.
THE EBR-2 MATERIALS SURVEILLANCE PROGRAM. PART 1: PROGRAM AND RESULTS OF SURV-1
Sherman Greenberg, comp. Sep. 1969 40 p
(Contract W-31-109-eng-38)
(ANL-7624) Avail: CFSTI

Eight subassemblies containing 15 alloys used in the primary system of EBR-2, and shield graphite canned in Type 304 stainless steel are being irradiated in the EBR-2 core at 700°F for varying periods of time and neutron dosage. Most of the alloy specimens are exposed directly to reactor sodium, and the remainder are sealed in helium. The alloys include aluminum bronze; Stellite 6B; Inconel X-750; T-1 tool steel; beryllium copper; Types 304, 347, 416, and 420 stainless steel (the Type 304 in four variations); Type 17-4 PH stainless steel; and tantalum. The first subassembly (SURV-1) has been removed, and examined after 671 days in the reactor and an estimated average fluence of 3×10 to the 19th power n/sq cm at energy levels >0.82 MeV. Of the materials exposed, only the beryllium copper and tantalum experienced appreciable weight loss, and thus appear to be unsuitable for use in contact with sodium under the conditions of the test. Author (NSA)

N70-24104# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
THE 550 F NOTCHED HIGH-STRAIN BEHAVIOR OF THREE LOW-STRENGTH STRUCTURAL STEELS
E. E. Krempl Aug. 1969 29 p refs
(Contract AT(04-3)-189)
(GEAP-10090) Avail: CFSTI

The 550 F high-strain fatigue behavior of unnotched and notched specimens of a 2-1/4 Cr-1 Mo steel, a carbon steel, and a Type-304 stainless steel was investigated. The notched behavior was determined for double-edge notched flat plates under zero-to-tension loading, and grooved cylinders under completely reversed loading. Crack initiation and failure were determined in the range of 100 to 100,000 cycles. The cyclic stress-strain diagram, smooth-bar data, and crack-initiation data of the notched specimens were used to determine the fatigue strength reduction factor for crack initiation. Values are given for three different definitions of

that factor. Average crack growth rates were determined, and striation density measurements were evaluated. The 500 F results are compared to earlier room temperature results for these same three materials. The largest effects of temperature were exhibited by Type-304 stainless steel. Author (NSA)

N70-24105# TRW Systems Group, Redondo Beach, Calif. Heavy Section Steel Technology Program.
GROSS STRAIN MEASURE OF FRACTURE TOUGHNESS OF STEELS Technical Report, Sep. 1968 - Nov. 1969
P. N. Randall 1 Nov. 1969 81 p refs Prepared for Oak Ridge Natl. Lab.
(Contract W-7405-eng-26)
(HSSTP-TR-3; TR-3) Avail: CFSTI

This project was part of an effort to ensure the safety of pressure vessels by developing quantitative means for design against brittle fracture. In the gross-strain approach to such design there are three key variables: maximum expected strain level; maximum expected flaw severity at that location; and minimum expected fracture toughness of the material at that location at the concurrent temperature, measured in terms of critical gross strain in the presence of sharp cracks of certain sizes. An experimental program was conducted to make such measurements. Key independent variables studied were: flaw size, constraint (specimen thickness and width) temperature, and stress-strain behavior in the yield region. Critical values quoted for these quantities were those at maximum load. Test specimens were rectangular tensile bars from plate 01 with thicknesses of 0.49 to 1.40 inches and widths from 1.40 to 4.00 inches. Test results generally revealed transition-temperature behavior. Author (NSA)

N70-24110# Aberdeen Proving Ground, Md. Ballistic Research Labs.
VAPORIZATION WAVE TRANSITIONS
F. D. Bennett Nov. 1969 31 p refs
(AD-699314; BRL-R-1456) Avail: CFSTI CSCL 19/1

A vaporization wave analogous to the unsteady simple wave in an expanding gas is proposed to account for phenomena observed in the evaporation of superheated metals. The vaporizing model is visualized on thermodynamic grounds as carrying the liquid metal through a continuous succession of states either on or near the liquidus line in the two-phase region. On this line, the adiabatic sound speed for wet vapor will limit the rate of propagation of the vaporization front into the liquid. Experimental data for wire explosions of Al, Ag, Cu, Au, Pn, and Hg (frozen) are analyzed for wave speeds. While the influence of thermal expansion of the liquid can be accounted for theoretically, insufficient thermal data are available for the metals to permit correction of the wave speeds for this effect. The experimentally derived wave speeds are compared with theoretical values of the adiabatic sound speed in the wet vapor obtained from a modified van der Waals equation of state. At low velocities, the agreement is satisfactory but higher values deviate considerably from theory. Author (TAB)

N70-24113# California Inst. of Tech., Pasadena. Keck (W. M.) Lab. of Engineering Materials.
RADIAL DISTRIBUTION FUNCTION OF AMORPHOUS NI-PT-P ALLOYS
Ashok K. Sinha and Pol Duwez Nov. 1969 22 p refs
(Contract AT(04-3)-221)
(CALT-221-80) Avail: CFSTI

Accurate X-ray diffraction measurements were made upon amorphous alloys having the composition (Ni sub x Pt sub 100 −x) sub 75 P sub 25 with 20 < or = to x < or = to 60, which were obtained by rapid quenching from the liquid state. The shapes of the interference function a(K), and of the atomic radial distribution function (RDF) curves are strikingly similar to those observed for metallic liquids. Contrary to what was observed in previously studied amorphous metallic alloys, there is no shoulder on the high angle side of the second peak of a(K) and the RDF does not have a double peak beyond the first maximum. The ratio of second to first near-neighbor atomic distances is 1.87 + or − 0.01, a value which is larger than that observed for previously known amorphous films. The first coordination number is close to 12. On the basis of these and further experimental studies on the first band of various amorphous metallic alloys, it is concluded that the present alloys possess a higher degree of disorder than that found in any of the existing amorphous metallic materials. The degree of disorder is comparable to that present in fused silica. Author (NSA)

N70-24133# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECTS OF SPECIMEN STORAGE AND CLEANING TECHNIQUES ON THE FATIGUE LIFE OF DTD 683 ALUMINIUM ALLOY
R. C. Beckett Dec. 1968 12 p refs
(ARL/SM-334) Avail: CFSTI

Rotating cantilever fatigue tests were made on unnotched specimens of aluminum alloy to investigate the effects of two cleaning and three storage procedures prior to testing. Statistical analysis showed that the results were not significantly affected by these variables. The results are discussed in relation to recent work which suggests that high humidity either during storage or testing can markedly affect the fatigue lives of some aluminum alloys. Author

N70-24141# Scientific Translation Service, Ann Arbor, Mich.
ROLE OF NIOBIUM IN THE IMPROVEMENT OF THE MECHANICAL PROPERTIES OF WELDABLE CONSTRUCTION STEELS
Pierre Mandry [1969] 49 p refs Transl. into ENGLISH from Metaux (Corrosion-Ind.) (St.-Germain-en-Laye), v. 43, 1968 p 24-48 Prepared for Oak Ridge Natl. Lab.
(ORNL-TR-2246) Avail: CFSTI

The physical properties of niobium are reviewed with special attention to solubility properties. The hypotheses of the mechanism by which niobium improves hardening in steels are summarized. The effects of niobium additions on austenite, ferrite, and martensite are considered. In the immediate vicinity of the welding bead, fusion of the metal caused coarsening of the grain and additional embrittlement due to the niobium which was observed after austenitization at 1300 C and accelerated cooling. Since niobium dissolved in the austenite enhanced its hardenability, significant bead hardnesses can be expected because of the appearance of mixed decomposition products during cooling. NSA

N70-24146# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
KINETICS OF COARSENING OF THE GAMMA-PRIME PRECIPITATE IN NICKEL-SILICON ALLOYS
P. K. Rastogi Oct. 1969 53 p refs
(Contract AT(04-3)-221)
(CALT-221-78) Avail: CFSTI

The coarsening kinetics of Ni3Si (gamma) precipitate in a binary Ni-Si alloy containing 6.5 wt % silicon was studied by magnetic techniques and transmission electronmicroscopy. A calibration curve was established to determine the concentration of silicon in the matrix. The variation of the Si content of the Ni-rich matrix as a function of time followed Lifshitz and Wagner theory for diffusion controlled coarsening phenomena. The estimated values of equilibrium solubility of silicon in the matrix represent the true coherent equilibrium solubilities. The experimental particle-size distributions and average particle size were determined from dark field electron micrographs. The experimental distributions of particle sizes differed slightly from the theoretical curve at the early stages of aging, but the agreement was satisfactory at the later stages. The values of diffusion coefficient of silicon, interfacial energy, and activation energy were calculated from the results of coarsening kinetics. Author (NSA)

N70-24152# Aeronautical Research Labs., Melbourne (Australia).
A TWO-PHASE DAMAGE THEORY FOR LIFE DISTRIBUTION PREDICTION
M. J. O'Neill Oct. 1968 30 p refs
(ARL/SM-322) Avail: CFSTI

A two-phase damage accumulation hypothesis is proposed to explain some features of the results obtained in rotating bending tests on D.T.D. 683 high strength aluminum alloy. The results of life calculations using this hypothesis are presented and compared with the observed lives and with Miner rule predictions for a number of step tests and one program test. The two-phase rule appears generally superior to the Miner rule but at some expense in computation and with the added complexity of requiring cycles in each phase rather than total cycles to failure at each stress condition. Some of the tests show a coaxing effect, a phenomenon which is not predicted by the damage hypothesis in its present form. Author

N70-24169# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF THE INITIAL RATE OF LOADING ON FATIGUE LIFE
R. C. Beckett Oct. 1968 17 p refs
(ARL/SM-331) Avail: CFSTI

Rotating cantilever tests on notched and unnotched 2024 aluminum alloy specimens were made to check the effect on fatigue life of rates of application of test load of 15 psi and 560 psi per cycle. Contrary to previous reports no significant effect was found. Author

N70-24173# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
RELATIONSHIPS BETWEEN THE ENERGIES OF VACANCY FORMATION AND VACANCY MIGRATION AS WELL AS OF THE ACTIVATION ENERGY OF DIFFUSION AND THE DEBYE TEMPERATURE OF METALS [BEZIEHUNGEN ZWISCHEN DER LEERSTELLENBILDUNGS-UND-WANDERUNGSENERGIE SOWIE DER AKTIVIERUNGSENERGIE DER DIFFUSION UND DER DEBYE-TEMPERATUR VON METALLEN]
G. M. Neumann Nov. 1969 13 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 56, no. 5–6, 1967 p 342–351
Prepared for Lincoln Lab., MIT
(AZT-69-631-GELL) Avail: CFSTI

It is demonstrated that certain relationships exist between the Debye temperature and the energies of vacancy formation and vacancy migration as well as the activation energy of diffusion which enable these energies to be computed with an accuracy to within 10%. Author

N70-24242*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
EVALUATION OF REFRACTORY/AUSTENITIC BIMETAL COMBINATIONS
R. W. Buckman, Jr. and R. C. Goodspeed Washington NASA Apr. 1970 115 p refs
(Contract NAS3-7634)
(NASA-CR-1516; WANL-PR-(EE)-004) Avail: CFSTI CSCL 11F

The interdiffusion behavior between 16 refractory/austenitic bimetal sheet combinations was investigated at 1400, 1500, and 1600 F for times up to 2700 hours. The bimetal composites, produced by explosive bonding, were made up of columbium, tantalum, Cb-1Zr, FS-85, and T-222 in combination with types 321 and 347 stainless steel and the nickel base alloys Inconel 600 and Hastelloy N. Detailed evaluation, which consisted of room temperature tensile strength, 1350 F creep rupture strength, and cyclic and isothermal testing, was conducted on nine selected combinations. It was concluded that the optimum refractory/austenitic bimetal combination evaluated was tantalum/321 stainless steel. Author

N70-24249*# McDonnell-Douglas Astronautics Co., Newport Beach, Calif. Astropower Lab.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS Quarterly Progress Report, Oct. – Dec. 1969
T. L. Mackay Jan. 1970 33 p refs
(Contract NAS7-488)
(NASA-CR-109492; SM-49105-Q10) Avail: CFSTI CSCL 11F

The effect of aluminum concentration on the stress corrosion susceptibility of alpha-titanium in aqueous salt environments at ambient temperature was studied. Five experimental alloys with aluminum concentrations from 5.0 to 7.0 weight percent were prepared. Preliminary results indicate that susceptibility to stress corrosion cracking begins with a concentration of 5.5 weight percent aluminum. The susceptibility increases very rapidly above 5.5 w/o aluminum. An analysis was made of the effect of a stress field at 450 F and 600 F precipitation of hydrides in pure titanium containing 0.76% hydrogen. Two possibilities which would explain the presence of large precipitates in pure titanium with the hydrogen content considerably below the solubility limit were considered. The estimated shift in the solubility equilibrium curve was found to be negligible and clearly indicate that the large gamma hydride precipitates observed in alpha-titanium did not occur during the stressing cycle. It seems logical to assume that the dislocations which are introduced into the alpha-titanium during the stressing cycle serve as nucleation sites for gamma hydride precipitates during quenching cycle. Author

N70-24254*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
HIGH TEMPERATURE (800 TO 1600 F) MAGNETIC MATERIALS
P. E. Kusser, K. Detert, J. W. Toth, and R. J. Towner Washington NASA Mar. 1970 344 p refs
(Contract NAS3-6465)
(NASA-CR-1460; WAED-67.34E) Avail: CFSTI CSCL 11F

An experimental investigation was performed to improve the performance of magnetic materials suitable for application in advanced rotating machinery. Four major areas were investigated: (1) Precipitation hardened magnetic materials; (2) Raising the alpha to gamma transformation temperature in cobalt-iron alloys; (3) Dispersion strengthened magnetic materials; and (4) Creep testing of Nivco alloys. The equipment and experimental results and conclusions are presented. Materials are described that are suitable for operation in the 800 to 1600 F range. Comparisons are made between the magnetic properties for the new alloys and existing alloys. Application temperatures for the various materials are summarized. Author

N70-24295*# General Electric Co., Cincinnati, Ohio. Material and Process Technology Labs.
A STUDY OF THE EFFECT OF DOPING ON A CAST LOW-CHROMIUM, HIGH-STRENGTH, NICKEL-BASE ALLOY Final Report
C. S. Wukusick 4 Dec. 1969 108 p refs
(Contract NAS3-11149)
(NASA-CR-72643) Avail: CFSTI CSCL 11F

The objective of this program was to develop improved cast nickel-base superalloys through additions of reactive metals to improve oxidation/corrosion resistance. A total of 17 alloys based on modification of the NASA-TRW-VI-A alloy were evaluated in tensile, stress rupture, oxidation and hot corrosion tests. La additions were effective in improvement of the short-term hot corrosion resistance. However, in long-time tests the results were negative. Also, mechanical properties were seriously degraded. Modifications in the investment casting practice resulted in improved structures and mechanical properties but not equivalent to the base alloy. The doping additions apparently affect hot corrosion behavior through

their effects on surface oxide adherence rather than on overall composition. It is concluded that the concept is not adaptable to present investment casting practice. Author

N70-24321*# Boeing Co., Seattle, Wash. Solid State Physics Lab.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS; ELECTROCHEMICAL KINETICS, SCC STUDIES WITH Ti-8-1-1, SCC AND POLARIZATION CURVES IN MOLTEN SALTS, LIQUID METAL EMBRITTLEMENT, AND SCC STUDIES WITH OTHER TITANIUM ALLOYS Quarterly Progress Report, Period Ending 31 Dec. 1969
T. R. Beck, M. J. Blackburn, W. H. Smyrl, and M. O. Speidel Dec. 1969 108 p refs
(Contract NAS7-489)
(NASA-CR-109495; QPR-14) Avail: CFSTI CSCL 11F

The evaluation of cracking behavior of titanium and aluminum in a wider variety of environments was performed. Crack propagation in titanium alloys was studied in mercury, molten salts, organic solvents and aqueous environments. A great many similarities were found as to the effect of metal structure, stress and environment conditions on crack propagation velocity. A new and somewhat different type of stress corrosion cracking was found to occur in Ti:Mo type alloys and preliminary data for the alloy Ti:12Mo-6Zr-5 Sn (beta III) are described. Techniques including cinematography were refined for studies of electrochemical kinetics and for observation of crack growth in single metal grains. Author

N70-24332# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CONCENTRATION-DEPENDENCE OF THE DEBYE TEMPERATURE IN THE COPPER-NICKEL SYSTEM [DIE KONZENTRATIONSBHAENGIGKEIT DER DEBYE TEMPERATUR IM SYSTEM KUPFER-NICKEL]
A. Brandstetter et al Dec. 1969 11 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 59, no. 5, 1968 p 436-438
Prepared for Lincoln Lab., MIT
(AZT-69-627-GELL) Avail: CFSTI

The concentration dependence of the Debye temperature relative to room temperature manifests a change of direction at approximately 70 at. % Ni. Since the Curie temperature of this alloy is close to room temperature, an effect of the ferromagnetic order upon the characteristic temperature is to be assumed. Author

N70-24345# Royal Aircraft Establishment, Farnborough (England).
METALLURGICAL STUDY OF THE TA6V TITANIUM ALLOY [ETUDE METALLURGIQUE DE L'ALLIAGE DE TITANE TA6V]
Rene Lignon Sep. 1969 40 p refs Transl. into ENGLISH of French report ONERA-TP-356
(RAE-Lib-Trans-1395) Avail: CFSTI

The TA6V (T16A14V) alloy may contain different allotropic forms: the close packed hexagonal alpha phase, the body centered cubic beta phase, the close packed hexagonal alpha prime phase and eventually the omega phase, the existence of which has not been shown decisively. Beta and alpha are the only two states for which the alloy exists in homogeneous solid solution. Beta is stable above 980 C and alpha appears at room temperature after quenching from a temperature greater than 980 C. Alpha is always in a metastable equilibrium. Alpha can be present only in conjunction with at least one, of the two other phases beta or alpha. The omega phase (which is perhaps an heterogeneity in the composition of the beta phase) cannot be cooled without decomposition. The mutual reactions taking place between those various phases were studied, particularly by isothermal treatments of austenitised beta alloy. Author

N70-24378# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ADVANCED METALLIC MATERIALS FOR AEROSPACE APPLICATIONS Technical Report, Jan. - Jun. 1968
James K. Stanley and Harold Smallen 22 Sep. 1969 73 p refs
(Contract F04701-69-C-0066)
(AD-698327; TR-0066(5250-10)-3; SAMSO-TR-69-355) Avail: CFSTI CSCL 11/6

The low weight and high strength of composites, titanium alloys, superalloys, refractory metals, and beryllium make them useful for construction of aerospace vehicles. Present and projected uses of these materials for aerospace structures are discussed. Author (TAB)

N70-24387# Bureau of Mines, Rolla, Mo.
SURFACE TENSION AND DENSITY OF LIQUID TIN
Alfred E. Schwaneke and Wilbert L. Falke Apr. 1970 12 p refs
(BM-RI-7372) Avail: Issuing Activity

The surface tension from 240 to 844 C and the density from 236 to 583 C of 99.999 percent purity liquid tin was measured using the maximum bubble-pressure method. Results for surface tension (gamma) show gamma (dynes/cm) = 566.84 - 0.0476 T (C) with a standard error of + or - 1.9 dynes/cm. Results for density (rho) show rho (g/cu cm) = 7.16 - 0.00063 T (C) with a standard error of 0.012 g/cu cm. Comparisons with other data found in the literature are discussed. The experimental results are considered to be as good as any data presently available. Author

N70-24425# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE DERIVATION OF THE MECHANICAL EQUATION OF STATE OF METALS IN THE CREEP PROCESS
E. G. Konovalov et al 30 Jan. 1969 3 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 13, no. 8, 1969 p 697-699
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The mechanical equation of state for creep in metals is derived in the form of a partial differential equation connecting the strain tensor, the strain rate tensor, the stress tensor, the time, and the temperature. Author

N70-24530 Drexel Inst. of Tech., Philadelphia, Pa.
DEFORMATION BEHAVIOR OF CONTINUOUS-FIBER, METAL-MATRIX COMPOSITE MATERIALS
Harvey Perry Cheskis (Ph.D. Thesis) 1969 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-19881

The deformation behavior of continuous-fiber, metal-matrix composites was studied in terms of the in-situ deformation behavior of the matrix and the fibers. X-ray diffraction techniques were employed to monitor the stress-strain behavior of the composite components (matrix and fibers) as a function of total composite stress-strain behavior. This experimental technique provided a unique approach to the study of metal-matrix composites since the deformation response of the components could be measured in-situ while the composite was under load. The influence of residual stress, component mechanical properties, composite geometry, interfacial reactions, and stress interactions between the matrix and the fibers could be incorporated into the analysis of composite deformation behavior. Dissert. Abstr.

N70-24531 Johns Hopkins Univ., Baltimore, Md.
THE DYNAMICS OF STORED ENERGY IN 1100 ALUMINUM, TOUGH PITCH COPPER AND 70-30 BRASS
Andrew Miller Dietrich, Jr. (Ph.D. Thesis) 1969 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-21098

With a single step calorimetric technique, the dynamics of stored energy release has been examined experimentally in the

uniaxial compression of 1100 aluminum, tough pitch copper, and 70-30 brass. Different grain sizes in aluminum were found to respond similarly while in 70-30 brass two different grain sizes differed in their dynamic responses. All three materials were observed to release stored energy as heat after deformation was complete. This post deformation energy release was discovered to consist of two components and qualitative models have been proposed for them. The maximum values of the ratio of heat generated to mechanical work input are in agreement with published values and this parameter is not sensitive to the variations in initial conditions examined in this work. Dissert. Abstr.

N70-24532 Stevens Inst. of Tech., Hoboken, N.J.
THE EFFECT OF DEFORMATION FAULTING ON MECHANICAL PROPERTIES OF AUSTENITE AND OTHER FACE-CENTERED CUBIC POLYCRYSTALLINE ALLOYS
Ivan Anders Franson (Ph.D. Thesis) 1969 221 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-21289

The 75 F to 900 F mechanical properties of austenites exhibiting stacking-fault probabilities varying from 0.005 to 0.025 were studied in relation to observed macro- and micro-structural features. Such data were felt to be of potential importance to the study of thermomechanical processes applied to steel as well as to the deformation characteristics of polycrystalline face-centered cubic metals and alloys in general. Four experimental austenites containing 0.3 percent carbon and (A) 27Ni, (B) 18Ni-6Mn, (C) 8Ni-10Mn and (D) 5Ni-12Mn respectively, were processed. A fifth alloy, Hadfield's steel, 1.2C-13Mn, was obtained commercially. These alloys were shown to be stable below −100 F. X-ray diffraction data were used to determine values for stacking-fault probability. Dissert. Abstr.

N70-24545# Michigan Univ., Ann Arbor.
PLASTIC DEFORMATION OF SINGLE CRYSTALS BY PLANE-STRAIN COMPRESSION Final Report, 2 Feb. 1965 – 31 Dec. 1969
William F. Hosford 1969 7 p refs
(Contract DA-31-124-ARO(D)-321)
(AD-699417; AROD-5407.7-MC) Avail: CFSTI CSCL 20/2

Single crystals of Mg and Mg-4Li and Mg-.4Th alloys were grown and tested in plane-strain. Tests were also made on textured polycrystalline sheets of these alloys. Crystals of Al-4Cu were prepared by strain-anneal techniques and subjected to plane-strain compression tests. Author (TAB)

N70-24560 Drexel Inst. of Tech., Philadelphia, Pa.
FRACTURE AND DUCTILITY IN HOT WORKING OF METALS
Eugene Shapiro (Ph.D. Thesis) 1969 234 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-19786

Fracture of Nickel 270 and Inconel 600, under conditions of warm working and hot working, was studied using a combined stress hot torsion testing device. Under all conditions, fracture initiates as wedge type cracks at the peak in the torque-twist curve. A hot fracture initiation criterion is proposed based on the initial deformation conditions. The higher the temperature and the slower the strain rate the smaller the strain at which fracture initiates. Under hot working conditions, fracture propagates slowly and deformation aided diffusion processes predominate. Under conditions of warm working, fracture propagates more rapidly and grain boundary sliding and bulk deformation processes predominate. The effect of superimposed axial tensile and compressive stresses on fracture initiation and fracture propagation is discussed. Dissert. Abstr.

N70-24581 Johns Hopkins Univ., Baltimore, Md.
EXPERIMENTAL STUDIES OF LATENT WORK HARDENING OF ALUMINUM SINGLE CRYSTALS
Nelson Nai-Hsing Hsu (Ph.D. Thesis) 1969 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-21094

The classical single slip theory of the plastic deformation of f.c.c. crystals was examined experimentally. The microscopic observation of the slip traces, the macroscopic measurements of the three dimensional shape changes, and the X-ray Laue back reflection were employed to determine the macroscopic deformation of aluminum single crystals of various axial orientations tested under simple tension or under tension after prior lateral loading. Based on the assumption of single slip, formulas of calculating the cross sectional dimension changes for rectangular cross section single crystals of arbitrary orientations were developed. These formulas provide one with a method of checking the validity of the single slip model. Dissert. Abstr.

N70-24582 Pennsylvania Univ., Philadelphia.
THE DETERMINATION OF THERMODYNAMIC ACTIVITIES IN SOME LIQUID METAL SYSTEMS BY MASS SPECTROMETRY
Michael Joseph Ginsberg (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-21355

The activity of silver in the liquid silver-gold system and of silver and copper in the liquid silver-copper system have been measured using the Knudsen cell-mass spectrometer combination. Two types of mass spectrometer were utilized, the time-of-flight for the silver-gold system and a magnetic deflection instrument for the silver-copper system. Four experimental techniques were employed, these being the internal standard method, where an inert, congruently vaporizing substance is included with the alloy in the cell and is used as vaporization standard, the monomer-dimer ratio method, where the dimer concentration in the vapor phase is used as the standard, the double crucible Knudsen cell method, where the ion currents from two cells, one containing the alloy and one the pure material are compared in a single experiment, and the Gibbs-Duhem integration method. Dissert. Abstr.

N70-24627# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
SCANNING ELECTRON MICROSCOPE FRACTOGRAPHY OF A URANIUM-7.5 WEIGHT PERCENT NIOBIUM-2.5 WEIGHT PERCENT ZIRCONIUM ALLOY
R. K. Bennett and F. R. Winslow 19 Aug. 1969 18 p refs
Presented at the 27th Ann. Electron Microscopy Soc. of Am., St. Paul, Minn., 26-29 Aug. 1969
(Contract W-7405-eng-26)
(Y-DA-2952; CONF-690810-2) Avail: CFSTI

Studies showed that the use of the scanning electron microscope for fractographic study instead of conventional replica techniques in the transmission electron microscope not only shortened the time necessary to obtain the data, but also furnished information concerning the deep cracks which might have been difficult to obtain or even lost using the replica technique. Author (NSA)

N70-24633 Pennsylvania Univ., Philadelphia.
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF SOLID REFRACTORY METAL ALLOYS: THE TANTALUM-MOLYBDENUM, TANTALUM-TUNGSTEN AND NIOBIUM-MOLYBDENUM BINARY SYSTEMS
Subhash Chandra Singhal (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-21429

The thermodynamic properties of the solid Ta-Mo, Ta-W and Nb-Mo alloys have been determined between 1000 and 1300 K by employing solid state galvanic cells with ThO2-Y2 O3 electrolytes. These alloy systems exhibit negative deviations from Raoult's law. The negative deviation from ideality is greater for the Ta-Mo system and decreases from Nb-Mo to Ta-W system. It is

believed that a charge transfer occurs on alloying causing the large negative deviation from ideality. The excess entropies of mixing in these alloy systems are very small and negative, and the excess free energies of mixing are largely due to the heats of mixing contribution. The excess entropies of mixing have been interpreted in terms of possible long or short range ordering in these alloy systems, but no definite x-ray evidence has been obtained. Dissert. Abstr.

N70-24634 Carnegie-Mellon Univ., Pittsburgh, Pa.
SLIP LINES AND DISLOCATION ARRANGEMENTS IN SILVER
John Adam Spitznagel (Ph.D. Thesis) 1969 282 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 69-19108

Slip lines and dislocation arrangements in silver are discussed. Tensile deformation of silver single crystals with four external faces and a tensile axis proceeds by duplex slip with very little easy glide. Stage II deformation is characterized by structurized fine slip on both primary and critical slip systems and is similar to that observed during Stage II deformation of copper crystals initially oriented for easy glide. It is also accompanied by the formation of a dislocation cell structure similar to that observed on copper crystals oriented for multiple glide. Active slip lines formed during 4% strain increments usually terminate at dislocation cell walls revealed by etch-pitting prior to or immediately after deformation. The slip lines cross, on the average, two to five cell walls without diminishing in intensity before they stop. The flow stress is proportional to the square root of the dislocation density and inversely proportional to the square root of the mean cell size. Dissert. Abstr.

N70-24652*# Rensselaer Polytechnic Inst., Troy, N.Y.
MECHANICAL PROPERTIES AND STRENGTHENING MECHANISMS
In its Mater. Res. Mar. 1970 p 39–57 ref (See N70-24649 11-34)
Avail: CFSTI CSCL 11F

Strengthening mechanisms in metal alloys is discussed. The role of localized stresses at the interfaces of dispersed phases was demonstrated in a comparison of yield testing in tension and compression. The creep behavior of silver-gallium oxide alloys was related to temperature and stress using basic rate theory expressions and the effects of magnesium, or copper on the creep on sintered aluminum are reported. Other topics reported, include: deformation and fracture of alloyed ferrite, internal friction behavior of aluminum-zinc eutectoid, yielding and flow of polymers, and the mechanism of toughening. Author

N70-24659*# National Aeronautics and Space Administration, Washington, D.C.
TITANIUM ALLOYS FOR MODERN TECHNOLOGY
N. P. Sazhin et al Mar. 1970 339 p refs Transl. into ENGLISH of the publ. "Titanovyye Splavy Dlya Novoy Tekhniki" Moscow, Nauka Press, 1968 p 1–271
(NASA-TT-F-596) Avail: CFSTI CSCL 11F

Discussed are metallurgy, metal working, and production of titanium and titanium alloys. Considered are interactions of titanium with other elements, phase transformations in titanium alloys, and effects of physical-mechanical treatments on titanium alloy characteristics. Aspects of economical production engineering of commercial titanium alloys are also considered. For individual titles, see N70-24660 through N70-24693.

N70-24660*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS OF THE DEVELOPMENT OF PRODUCTION OF TITANIUM SPONGE
N. P. Sazhin *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 1–7 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The history of the development of titanium metallurgy as an autonomous branch of industry is presented. Problems of the creation of the principal technological processes are elucidated on selecting as the main orientation the chlorine method of processing the raw material. The chief tasks facing the titanium industry are formulated. Author

N70-24661*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS OF DEVELOPMENT OF THE PRODUCTION OF INGOTS AND SEMIFINISHED PRODUCTS FROM TITANIUM ALLOYS
A. F. Belov *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 8–10 (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Certain most important problems in the development of the production of rolled titanium alloy stock are considered. The principal tasks of titanium production are substantiated: further expansion of the output of sponge and rolled stock, a sharp increase in the operating economy of production and a reduction in prices. Author

N70-24662*# National Aeronautics and Space Administration, Washington, D.C.
MODERN TITANIUM ALLOYS
S. G. Glazunov *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 11–22 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

A critical review of the specifications for titanium alloys existing in the USSR, United States and Great Britain is presented. The main trends of the development of titanium alloys are described and certain results of investigations of delayed fracture, cracking sensitivity and diagrams of stressed state are presented. Author

N70-24663*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS OF RESEARCH IN METAL CHEMISTRY OF TITANIUM
I. I. Kornilov *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 23–35 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The principal results of studies of the metal chemistry of titanium are presented and the tasks of further research in this direction are outlined. In addition, the methods of compounding and specific compositions of titanium-base alloys that remain highly plastic at cryogenic temperatures, as well as of high-strength, high-temperature and corrosion-resistant alloys and also of materials with special physical properties are examined. Author

N70-24664*# National Aeronautics and Space Administration, Washington, D.C.
IMPROVING THE TECHNOLOGY OF PRODUCTION AND QUALITY OF SEMIFINISHED PRODUCTS FROM TITANIUM ALLOYS
G. D. Agarkov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 35–40 (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The results of refinements in the production technology and improvements in the quality of semifinished products are assessed. Main trends of the further development of production are discussed. The possibilities for expanding the production of stampings instead of forgings, welded wheels instead of forged and rolled wheels, and also of rolled rods, welded tubes and intricately shaped castings are considered. The rolling of merchant shapes as the most progressive method for fabricating semifinished products

and intermediate billets of titanium alloys is analyzed. Problems of eliminating metallurgical defects in ingots, improving the surface quality of semifinished products, reducing the grain size of the structure of hot-deformed products and stabilizing and increasing properties are examined. Author

N70-24665*# National Aeronautics and Space Administration, Washington, D.C.
HEAT TREATMENT OF TITANIUM AND ITS ALLOYS
V. A. Livanov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 41–54 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The work establishes the heat treatment regimes of titanium alloys. The authors examine the formation of metastable phases in titanium alloys on cooling from the beta-phase region as well as the kinetics of their formation in the process of aging. Diagrams of isothermal transformations of titanium alloys in relation to the content of beta-isomorphic stabilizers are presented. Regimes of heat treatment of the alloys VT-15 and VTZ-1 are substantiated. Author

N70-24666*# National Aeronautics and Space Administration, Washington, D.C.
THERMOMECHANICAL TREATMENT OF CERTAIN TITANIUM ALLOYS
I. M. Pavlov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 55–67 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The effect of thermomechanical treatment on the strength and plasticity properties of alpha', (alpha+beta)- and beta-alloys of titanium is investigated. The variation in mechanical properties of single-phase titanium alloys is then found to be insignificant. In two-phase alloys the strength and plasticity properties increased. The high-alloy compositions based on two-phase Ti corresponded to a marked strengthening effect of thermomechanical treatment. It was established that the increase in the plasticity following thermomechanical treatment is associated with the variation in the pattern and nature of fracture in tensile-test specimens. Aspects of fracture during thermomechanical treatment are investigated. Author

N70-24667*# National Aeronautics and Space Administration, Washington, D.C.
PROBLEM OF UTILIZING TITANIUM SCRAP AND APPLICATIONS OF SECONDARY TITANIUM
A. I. Kanyuk et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 68–75 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The problem of utilizing the wastes of titanium industry, the quantities of which increase with each year, is considered. It is shown that the utilization of the wastes of titanium production makes it possible to reduce the cost of titanium ingots and to save a large amount of valuable alloying elements. At present about one-third of all titanium wastes is utilized for the need of ferrous metallurgy, but such utilization is inefficient. The most efficient solution is the utilization of the wastes to produce secondary alloys of a composition close to that of the original raw material. Author

N70-24668*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS OF ADOPTION OF TITANIUM
A. I. Kanyuk et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 76–83 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The principal results of studies of the metal chemistry of titanium are presented and the tasks of further research in this direction are outlined. In addition, the methods of compounding and specific compositions of titanium-base alloys that remain highly plastic at cryogenic temperatures, as well as of high-strength high-temperature and corrosion-resistant alloys and also of materials with special physical properties are examined. Author

N70-24669*# National Aeronautics and Space Administration, Washington, D.C.
PROSPECTS FOR THE USE OF NEW TITANIUM ALLOYS IN CHEMICAL MACHINE BUILDING
Yu. M. Vinogradov *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 84–88 (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Examples of successful operation of titanium-alloy apparatus in chemical machine building are presented. The corrosion resistance and possible range of applications of new alloys of titanium with molybdenum, with molybdenum and niobium, and also with tantalum, are described. Author

N70-24670*# National Aeronautics and Space Administration, Washington, D.C.
PHASE DIAGRAM OF A PART OF THE TERNARY SYSTEM Ti-Al-V (UP TO 45% Al)
I. I. Kornilov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 89–101 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Alloys of the ternary system Ti-Al-V containing 0-45% Al are investigated by methods of thermal, microstructural and X-ray analysis as well as of resistivity and hardness measurements. Isothermal sections of the system are constructed for 1100, 800, 550 C, as are polythermal sections starting from the pure-Ti vertex for Al/V ratios of 3:1, 1:1 and 1:3. The following phases are identified in the system: alpha,alpha sub 2(Ti3Al), beta, gamma (TiAl), delta(V5Al2). It is established that the phases gamma and delta exist in equilibrium. Author

N70-24671*# National Aeronautics and Space Administration, Washington, D.C.
STUDIES OF THE PHASE EQUILIBRIUM AND CERTAIN PROPERTIES OF ALLOYS OF THE SYSTEM Ti-Al-Mo-Zr RICH IN TITANIUM
I. I. Kornilov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 102–110 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Alloys of the system Ti-Al-Mo-Zr containing up to 30% Al + Mo + Zr are investigated by methods of microstructural and x-ray analysis and resistivity and hardness measurement. The compositions of the alloys investigated were selected from two cross sections of the tetrahedron passing through the edge Ti-Al and the face Ti-Mo-Zr, with Mo/Zr ratios of 3:1 and 1:3 over the sections with 3, 6, 9, 12, 16 and 22% Al. Isothermal sections of the system are constructed at 1100, 800 and 500 C. The existence of alpha-, beta- and alpha sub 2(Ti3Al)-solid solutions and corresponding two- and three-phase regions is established. Author

N70-24672*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE EQUILIBRIUM AND PROPERTIES OF ALLOYS OF THE SECTION Ti3 Sn-(Ti + 5% Zr) OF THE SYSTEM Ti-Zr-Sn
N. I. Shirokova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 111–115 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The interaction between the intermetallic compound Ti3Sn and the solid solution of Ti + 5% Zr is investigated for alloys prepared by the melting method in a helium-atmosphere arc furnace and remelting in suspended state. A polythermal section from the composition of the Ti3Sn compound to the composition of the Ti + 5% Zr alloy is constructed with the aid of methods of microstructural and thermal analyses. The established nature of

chemical interaction of titanium with zirconium and tin resembles the interaction between titanium and the compound Ti3Sn in the binary system Ti-Sn, as confirmed by investigation of the resistivity and hardness of various alloy compositions. Author

N70-24673*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE PHASE EQUILIBRIUM AND PROPERTIES OF ALLOYS OF THE TITANIUM CORNER OF THE SYSTEM Ti-Zr-Al
N. I. Shirokova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 116–122 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Two polythermal sections in the part of the system Ti-Ar-Al adjoining the Ti-Al side are constructed with the aid of methods of thermal and microstructural analysis: (1) radial, from the Ti + 5% Zr composition to the compound Ti3Al; and (2) parallel to the Ti-Al side with 5% Zr. It is established that interaction between titanium and zirconium and aluminum over both cross sections resembles the interaction between titanium and aluminum in the binary system Ti-Al. The established nature of chemical interaction of the components is confirmed by investigation of properties of the alloys. With the aid of the centrifugal method of bending tests at 700 C it is established that the maximum high-temperature strength is displayed by the alloy with 5% Zr and 9% Al. Author

N70-24674*# National Aeronautics and Space Administration, Washington, D.C.
NATURE OF HYDROGEN BRITTLENESS OF TITANIUM AND ITS ALLOYS
B. A. Kolachev et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 123–137 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

A classification of the types of the hydrogen brittleness of metals, based on the origin of the sources of this brittleness, is presented. Analytic formulas relating the basis parameters which determine hydrogen brittleness of titanium and its alloys are presented. Author

N70-24675*# National Aeronautics and Space Administration, Washington, D.C.
METASTABLE PHASES IN THE ALLOYS OF TITANIUM WITH beta-ALLOYING METALS
L. A. Petrova *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 138–152 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The published literature as well as the author's data on metastable phases in titanium alloys are examined. Depending on the beta-alloying elements forming the eutectoid or isormorphic to beta-Ti, the metastable alpha', omega and beta phases or alpha'', alpha' , omega and beta phases form in titanium alloys. The martensitic alpha' phase has, like alpha-Ti, a hexagonal close-packed lattice, while the alpha'' phase, although it has a martensitic structure like the alpha' phase, displays a rhombic lattice; the omega phase occurs during quenching, its mechanism of formation is non-diffusive and it has a hexagonal structure; the beta-solid solution forms in alloys in the presence of a specific electron concentration. Author

N70-24676*# National Aeronautics and Space Administration, Washington, D.C.
PHASE TRANSFORMATIONS IN TITANIUM ALLOYS UNDER NONEQUILIBRIUM CONDITIONS
M. A. Dyakova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 153–159 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The principal conditions for the formation of the metastable alpha', alpha'' and omega phases in alloys of titanium with transitional elements are examined. It is shown that the metastable phases display a lower free energy than the high-temperature phase. The decomposition of beta phase, which may occur through diffusive and nondiffusive displacement mechanisms, as well as due to an intermediate transformation, is examined. Depending on the temperature intervals, three stages of transformation are specified, as illustrated with a corresponding isothermal decomposition diagram of the beta phase. Author

N70-24677*# National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF TIN AND ZIRCONIUM ON TRANSFORMATIONS ACCOMPANYING THE HEAT TREATMENT OF THE ALLOY Ti + 10% Cr
L. P. Luzhnikov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 160–169 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The effect of the alpha-stabilizer Sn (up to 14%) and Zr (up to 16%) on the transformations accompanying the heat treatment of the alloy Ti+10% Cr (0.15-0.17% O2) is investigated. The dilatometric method, the method of constructing kinetic curves of aging and of recovery during aging and partly also the method of metallographic analysis were employed. The presence of 1% Sn or 2% Zr suppresses the formation of omega phase during quenching. Treatment with Sn and Zr to the maximum amounts practically does not harden the alloy in quenched state. A similar effect is produced by treatment with Al. Tin and zirconium affect very significantly the processes of the decomposition of beta-solid solution of the alloy during aging. However, the maximum hardening that can be attained by the quenching and a aging of the alloy treated with Sn and Zr is no higher than the hardening of the alloy not treated with these elements. The most marked effect on the processes of transformation during the aging of the investigated beta alloy is produced by Sn and a less marked effect, by Zr and Al. Author

N70-24678*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF PHASE AND STRUCTURAL TRANSFORMATIONS IN TWO-PHASE INDUSTRIAL TITANIUM ALLOYS
M. I. Yermolova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 170–180 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

With the aid of x-ray structural and electronmicroscopic methods of analysis the phase transformations accompanying the quenching and aging of the titanium alloys VTZ-1, VT8, VT14 and VT16 are investigated. In the investigated alloys were discovered three regions such that water-quenching from these regions results in fixing of the metastable phases beta, alpha' and alpha'', respectively. Depending on the degree of treatment with molybdenum these regions get displaced in position. The decomposition of the metastable phases beta, alpha' and alpha'' owing to aging at 400-600 C leads to a rise in the hardness of the alloys, which is attributable to the formation of a fine-disperse mixture of alpha and beta-phases (according to electronmicroscopic examination); the beta-phase decomposes at a lower temperature than the alpha' and alpha'' phases. Author

N70-24679*# National Aeronautics and Space Administration, Washington, D.C.
CHANGES IN THE AMOUNT AND COMPOSITION OF THE beta PHASE DURING HEAT TREATMENT OF THE ALLOY VTZ-1
Ye. I. Guskova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 181–186 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The variation in the amount, composition and disperity of the beta phase electrolytically isolated from the (alpha + beta)-titanium alloy VTZ-1 following quenching from 870 and

1000 C, as well as following high-temperature thermomechanical treatment and aging at 550 C, is investigated; following high-temperature thermomechanical treatment the beta phase is more disperse than following conventional quenching. Aging results in the decomposition of the alpha(alpha') phase into (alpha + beta) phases; the residual beta phase during aging coagulates and gets enriched with beta-forming elements (Cr, Mo, Fe). Author

N70-24680*# National Aeronautics and Space Administration, Washington, D.C.
DECOMPOSITION OF TITANIUM-VANADIUM MARTENSITE DURING HEATING
S. G. Fedotov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 187–193 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The decomposition of titanium-vanadium martensite during heating is investigated. This decomposition occurs by a displacive mechanism, within a specific range of temperatures. The start and end points of decomposition are determined by the chemical composition of martensite. As supersaturation increases, the start point of decomposition decreases. The temperature of martensite decomposition during heating is closely linked to the temperature of martensite formation during quenching of the alloys. The aging of martensite results in a marked hardening of alloys. Author

N70-24681*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF ALLOYS OF THE SYSTEM Ti-Al-Mo-Zr BY THE BENDING METHOD AT HIGH TEMPERATURES
N. G. Boriskina et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 194–201 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

Alloys of the system Ti-Al-Mo-Zr, containing up to 30% (Al-Mo-Zr) were investigated by the centrifugal bending method under a load of 15 kg/sq mm at 550, 600, 700 and 750 C. The compositions of the investigated alloys were selected from two cross sections of the tetrahedron passing through the Ti-Al edge and the Ti-Mo-Zr face with Mo/Zr ratio of 3:1 and 1:3 for the sections with 3, 6, 9, 12, 16 and 22% Al. It is established that the alloy compositions with the greatest high-temperature strength are located in the neighborhood of the phase interfaces alpha/(alpha + beta) or (alpha + alpha sub 2)/(alpha + alpha sub 2 + beta) in the presence of a small amount of 1 phase. Author

N70-24682*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE PROPERTIES OF ALLOYS OF THE SYSTEMS Ti-Zr AND Ti-Zr-Al
Ye. A. Borisova et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 202–207 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The work deals with alloys of titanium with 2, 4, 8, 12, 20, 40 and 65% Zr, without aluminum or containing 4, 6 and 7% Al. All the alloys were vacuum-annealed and then subjected to tensile tests at (-196)-(+700 C). Impact strength and Rockwell hardness were determined at room temperature. The temperature boundaries of phase regions of alloys of the systems Ti-Zr and Ti-Zr-Al were determined by metallographic and dilatometric methods, as was the coefficient of linear thermal expansion for the alloys Ti-Zr. The conducted investigation revealed that the alloys of the system Ti-Zr-Al containing 2-4% Al and 4-8% Zr are the most promising for further study with the object of developing a highly plastic alloy. Author

N70-24683*# National Aeronautics and Space Administration, Washington, D.C.
SOME PROBLEMS OF THE PHYSICOCHEMICAL THEORY OF HIGH-TEMPERATURE STRENGTH AND THE NEW HIGH-TEMPERATURE TITANIUM ALLOYS ST-1, ST-3, ST-4 AND ST-5
T. T. Nartova *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 208–220 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

In accordance with four basic types of equilibrium diagrams four types of "composition-high-temperature strength" diagrams are established. Binary titanium alloys are divided into these types according to the nature of the effect of alloying elements on the high-temperature strength of titanium. The established pattern of variation in the high-temperature strength of binary titanium systems is of significance to research into multicomponent titanium systems and to the determination of the optimal compositions of new high-temperature titanium alloys. The phase structure and mechanical and high-temperature properties of the alloys ST-1, ST-3, ST-4 and ST-5, developed on the basis of multicomponent titanium systems for performance at temperatures exceeding 600 C, are investigated. Author

N70-24684*# National Aeronautics and Space Administration, Washington, D.C.
CORROSION-RESISTANT ALLOY OF TITANIUM WITH 32% Mo
N. F. Anoshkin et al *In its* Titanium Alloys for Md. Technol. Mar. 1970 p 221–230 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The results of an investigation of certain technological and mechanical properties of the alloy TM32, which is corrosion resistant in hydrochloric-acid media at high temperatures, are presented. Data on the thermal stability as well as weldability of this alloy also are given. Author

N70-24685*# National Aeronautics and Space Administration, Washington, D.C.
PRINCIPAL PROPERTIES OF THE TITANIUM ALLOY AT-3 AND THE PROSPECTS FOR ITS APPLICATION
I. I. Kornilov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 231–238 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The stress-rupture strength, creep and thermal stability of the titanium alloy AT-3 at 300, 350 and 400 C for 15,000-20,000 hr are investigated. Curves of stress-rupture strength and creep at 350 and 500 C under various loads are constructed. It is established that at 350 C the alloy displays a high stress-rupture strength which is close to its ultimate short-time strength. This points to insignificant softening of the alloys under conditions of prolonged creep at 350 C. Creep rate at this temperature is relatively independent of load. During prolonged aging at 350-400 C for 10,000 hr no embrittlement occurs. The strength and plasticity of the alloy remain unchanged. Author

N70-24686*# National Aeronautics and Space Administration, Washington, D.C.
PARAMETERS OF THE DIFFUSION OF OXYGEN IN beta-TITANIUM
L. F. Sokiryanskiy et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 239–249 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The diffusion of oxygen in beta-titanium at 950-1150 C is investigated by the layer analysis method. The oxygen concentration was determined according to variation in the crystal lattice parameter. The results of the determination of diffusion coefficients within the investigated range of temperatures are described by an equation. This equation is satisfied for technical-purity titanium as well as for titanium purified by the iodide process. As shown by analysis of the structure of the obtained diffusion zones, oxygen diffusion in the alpha region of titanium proceeds more slowly than in the beta region. Author

N70-24689*# National Aeronautics and Space Administration, Washington, D.C.
FEATURES OF THE PRODUCTION TECHNOLOGY OF SEMIFINISHED PRODUCTS OF TITANIUM AND ITS ALLOYS
I. N. Kaganovich *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 274–288 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The process flowsheets and parameters for the fabrication of sheets, strip, forgings and stampings of various groups of titanium alloys are described. The effect of gas absorption and thermomechanical treatment on the properties of the semifinished products is examined. Author

N70-24690*# National Aeronautics and Space Administration, Washington, D.C.
PRODUCTION OF TUBES FROM TITANIUM AND ITS ALLOYS
V. Ya. Ostrenko *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 289–300 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The current production technology of 0.5-465 mm diameter tubes of all the series-produced alloys, as practiced at Soviet plants, is reviewed. Methods of further improving the production technology and quality of the tubes are illustrated. Author

N70-24691*# National Aeronautics and Space Administration, Washington, D.C.
EXTRUSION OF TITANIUM ALLOY SHAPES
O. S. Mironov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 301–304 (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The technology of extrusion and the effect of temperature and rate parameters of deformation on the structure and properties of industrial titanium alloy shapes are described. Author

N70-24692*# National Aeronautics and Space Administration, Washington, D.C.
DEFORMABILITY OF CERTAIN (alpha + beta) AND beta-ALLOYS OF TITANIUM IN COLD STATE
A. D. Lyuchkov et al *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 305–310 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The results of an investigation of the effect of the structure and phase composition of the alloys VT14, VT8, TiAl5V4Cr1.5Fe1.5, VT15 and Ti-32 Mo on deformability at room temperature under high loading rates are presented. It is concluded that in the presence of a high deformation rate the two-phase alloys VT14 and TiAl5V4Cr1.5Fe1.5 should be subjected to annealing and the alloy VT8, to quenching, in order to assure a higher plasticity level. Author

N70-24693*# National Aeronautics and Space Administration, Washington, D.C.
PROBLEMS OF THE WELDING OF TITANIUM AND ITS ALLOYS
S. M. Gurevich *In its* Titanium Alloys for Mod. Technol. Mar. 1970 p 311–321 refs (See N70-24659 11-17)
Avail: CFSTI CSCL 11F

The methods used to weld titanium and its alloys are analyzed. The advantages of pulsed-arc welding, submerged argon-arc welding, vacuum electron-beam welding and diffusion welding are described. It is concluded that automatic submerged arc welding is the principal technological process for joining segments of apparatus housings. Author

N70-24747# Army Materials and Mechanics Research Center, Watertown, Mass.
DEFORMATION BEHAVIOR IN METAL FIBER-METAL MATRIX COMPOSITES Technical Report
Richard M. Vennett, Stanley M. Wolf, and Albert P. Levitt Dec. 1969 23 p refs
(AD-699349; AMMRC-TR-69-31) Avail: CFSTI CSCL 11/4

A model system, brass-tungsten, was used to study the effect of multiple fiber necking, strain rate, and fiber surface condition on the ductility and deformation behavior of uniaxial metal matrix composites. Low volume percent (<20 v/o) composites were made using brass (90Cu-10Zn) powders and tungsten wires. Multiple necking of tungsten wires in a brass matrix was found to be a result of a load transfer from the wire to the surrounding matrix. Composite ductility was shown to increase with decreasing multiple neck spacing and increasing reduction of area at the neck and was generally independent of strain rate. The ability of metal matrix composites to undergo simple forming operations such as cold rolling and closed-die forging was also shown. Author (TAB)

N70-24775*# Aerojet-General Corp., Sacramento, Calif. Solid Propulsion Div.
STRUCTURAL AND METALLURGICAL EVALUATION OF THE 260-SL-3 CHAMBER Final Report
H. K. Whitfield Apr. 1970 136 p refs
(Contract NAS3-12039)
(NASA-CR-72676) Avail: CFSTI CSCL 11E

Twelve 0.60-in. (0.52 cm) thick, 18% nickel, 200 Grade, maraging steel test panels were removed from the 260-in. (6.6 m)-dia motor case to evaluate the structural and metallurgical characteristics of selected areas of the as fabricated production case. The areas investigated include: (1) measurement of a case thin spot, (2) structural and metallurgical evaluation of production automatic welds, defective welds, and nondestructive test indications in welds, and (3) structural and metallurgical evaluation of case hot spots that occurred during motor postfiring heatsoak. The program results showed that the material and fabrication process controls developed prior to the start of fabrication were successfully incorporated in the production of the 260-in. (6.6 m)-dia case. These production process controls resulted in acceptable case material properties. Author

N70-24819# National Lead Co. of Ohio, Cincinnati.
MICROSTRUCTURES OF AS-CAST URANIUM-BASE DILUTE ALLOYS
L. G. Wexlin and E. L. Schaich Feb. 1969 37 p refs
(Contract AT(30-1)-1156)
(NLCO-1022) Avail: CFSTI

Microstructures of 98 as-cast uranium-base dilute alloys were examined. The alloys were binary, ternary, quaternary, and quinary combinations of carbon, iron, aluminum, and silicon (1000 ppM or less of each) in uranium. Author (NSA)

N70-24840# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
DEVELOPMENT OF A CONTINUOUS, HARD-ANODIZED ALUMINUM SURFACE
Frank L. Harris and Sidney Levine May 1969 17 p refs
(AD-699350; USAMERDC-1952) Avail: CFSTI CSCL 11/3

A method is described for minimizing the effects of the discontinuities inherent in hard-anodized coatings on aluminum by the introduction of a secondary anodic film. Photomicrographs show the location of the secondary coating beneath the original hard-anodized finish. Data are presented which indicate that the method described has no ill effect on the original abrasion resistance and that the continuity of the coating is significantly increased. Author (TAB)

N70-24850# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
ELECTRON MICROSCOPE TECHNIQUES FOR SHOWING EMBRITTLEMENT IN 18 NI MARAGING STEEL

D. A. Gomrick and G. J. Spaeder Pittsburgh 1969 11 p *Its* Sci. and Technol. Vol. 16, No. 21
Avail: CFSTI

The microstructural changes that are responsible for severe embrittlement in 18Ni maraging steel cannot be observed with the light microscope. However, a sequence of two fairly simple metallographic procedures, each involving the use of the electron microscope, provides an explanation for the embrittlement. The first procedure involves an examination at high magnifications of the fracture-surface of embrittled and unembrittled samples, and the second procedure involves a similar examination of a polished and etched surface. The combination of the two procedures define the fracture path and also reveals the presence of a second phase that is responsible for the embrittlement. Author

N70-24942# United Kingdom Atomic Energy Authority, Harwell (England).
THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS. PART 1: THEORETICAL CONSIDERATIONS. PART 2: DISLOCATION PINNING
B. L. Eyre, ed. Dec. 1968 300 p refs Presented at the Symp. held at Harwell, 4 - 12 Jul. 1968
(AERE-R-5944-Vol-1-Pt-1-Pt-2; CONF-680715-Vol-1-Pt-1-Pt-2)
Avail: CFSTI

Conference papers were concerned with dislocation interactions with point defects, energy of atoms on edge dislocations, interactions of solutes with dislocations, theory of dislocation damping, and behavior of charged dislocations in NaCl. The effects of irradiation temperature on the nature of dislocation pinning in electron irradiated copper were investigated. Measurements of ultrasonic attenuation after irradiation at 220 K and subsequent annealing reveal two pinning stages centered at about 260 and 350 K. The activation energies were found for these stages. The ultrasonic attenuation was measured in a Pb single crystal during and following gamma irradiation in the room temperature range. NSA

N70-24946# United States Steel Corp., Monroeville, Pa. Research Center.
ELECTRICAL RESISTIVITY OF IRON-CARBON ALLOYS
H. Wagenblast and Sigurds Arajs Pittsburgh 1969 16 p refs Submitted for publication *Its* Sci. and Technol. Vol. 16, No. 23
Avail: CFSTI

The electrical resistivity of alpha iron-carbon solid solutions prepared from iron sources of two different general impurity levels was studied as a function of applied longitudinal magnetic field up to 60 kOe at 4.2 K. It is demonstrated that the presence of interstitial carbon increases the resistivity of iron and drastically alters the shape of the magnetoresistivity curves, particularly at low fields. The residual resistivity contribution per at.% carbon in solution in high-purity iron is about 4.9 microohm cm. At 78 K the value is approximately 6.0 microohm cm/at.% carbon, indicating a positive deviation from the Matthiessen rule. In comparison, the residual resistivity of a lower-purity iron is about 6.5 microohm cm/at.% carbon at both 4.2 and 78 K. The magnetoresistivity data for the two iron materials containing carbon in interstitial solid solution are shown to obey the Kohler rule to a moderate approximation. In addition, some data are presented which demonstrate the magnetoresistivity is dependent on the dispersion of the carbon in the iron. Author

N70-24948# United States Steel Corp., Monroeville, Pa. Research Center.
ELECTRICAL RESISTIVITY STUDIES OF IRON-NITROGEN SOLID SOLUTIONS
H. Wagenblast and Siguros Arajs Pittsburgh 1969 20 p refs Submitted for publication *Its* Sci. and Technol. Vol. 16, No. 17
Avail: CFSTI

The electrical resistivity of iron-nitrogen solid solutions prepared from high purity iron was studied as a function of applied longitudinal magnetic fields up to 60 kOe at 4.2 K. It is demonstrated that the presence of interstitial nitrogen increases the resistivity of iron and alters the shape of resistivity vs magnetic field curves. By extrapolating the data to B = 0, where B is the internal magnetic induction, it was possible to determine that the residual resistivity contribution per 1 at.% nitrogen in solid solution with iron. At 78 K, the value is approximately 7.0 microohm cm. Such a large positive deviation from the Matthiessen rule is characteristic for iron alloys with another transition metal as a solute. Magnetoresistivity data of iron-nitrogen solid solutions (but not pure iron) approximately obey the Kohler rule. Author

N70-24983# Royal Aircraft Establishment, Farnborough (England). Ministry of Technology.
THE FATIGUE PROPERTIES OF TITANIUM AND TITANIUM ALLOYS. PART 2: THE EFFECT OF IMPURITIES, SURFACE CONDITIONS AND TEST CONDITIONS ON THE FATIGUE STRENGTH [UEBER DAS DAUERSCHWINGVERHALTEN VON TITAN UND SEINEN LEGIERUNGEN. 2 EINFLUSS VON VERUNREINIGUNGEN DES OBERFLAECHENZUSTANDES UND DER PRUEFBEDINGUNGEN AUF DIE WECHSELFESTIGKEIT]
M. Hempel Oct. 1969 24 p refs Transl. into ENGLISH from Draht (German), v. 16, no. 4, 1965 p 209 - 218
(RAE-LIB-Trans-1399) Avail: CFSTI

The effects of the following factors on the fatigue strength of commercial purity titanium and a number of commercial and non-commercial titanium alloys are reviewed, (i) the presence of interstitial (O, H, N, C) and substitutional (Al, Sn) impurities, (ii) whether the test piece is cut longitudinally or transversely to the rolling or forging direction, (iii) various surface conditions, i.e. turning, milling, grinding and shot blasting, giving surface compressive or tensile residual stresses, chemical surface treatments, plating and electro-polishing and, (iv) different test conditions, i.e. test frequency, cooling with tap water, and sodium chloride solution. Author

N70-24992# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
PHASE IDENTIFICATION IN THE U-Si SYSTEM
L. C. Berthiaume Dec. 1969 15 p refs
(AECL-3517) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $.50

Eight phases (U, U3Si, U3Si2, USi, U2Si3, USi2, US3 and Si) are reported to occur in the uranium silicon system. The preparation of samples corresponding in composition to these phases, and the identification of each phase using the electron microprobe are described. The phases were characterized with respect to distribution, etching behavior and microhardness. The results permit identification of the phases without using the electron microprobe. Author

N70-24994# United States Steel Corp., Pittsburgh.
PHOSPHORUS LEVEL: EFFECT ON MACHINABILITY OF RESULFURIZED LOW-CARBON STEEL
H. J. Tata 1969 15 p ref *Its* Sci. and Technol. Vol. 16, No. 22
Avail: CFSTI

The results of closely controlled automatic screw machine studies on cold-drawn bars from three heats of 1215-type steels show that increasing the phosphorus content to levels above the 0.04 to 0.09 percent range for 1215 steel increases tool wear and generally impairs surface finish performance, and thus would be expected to decrease net output in production operations. For optimum machinability the phosphorus content of resulfurized low-carbon steels should correspond to the phosphorus content of 1215 steel. Author

N70-25003 Wisconsin Univ., Madison.
MORPHOLOGY OF THE SILICON PHASE AND EUTECTIC MODIFICATION IN ALUMINUM-SILICON ALLOYS
Eugene Michael Pilarski (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-12403

Determination of the morphology of modified eutectic Si from samples with various thermal treatments and provision of a more unified understanding of modification principles are presented. Unidirectional solidification was used to control growth temperature gradient, growth rate and heat transfer direction. Differential thermal analysis was used to investigate latent heat effects not evident on conventional cooling curves. X-ray diffractometry was employed to detect phases not microscopically present. Electron microscopy was used to determine the morphology and the crystallography of modified eutectic Si. Modified eutectic Si was found to be fibrous, frequently branched and interconnected. With modified alloys, Na was detected in the microstructure as a randomly distributed NaAlSi compound. It was concluded that the role of the modifying element was to lower the nucleation of Si to a temperature where the fibrous morphology characteristically grows. Temperature was more important than the presence of Na in determining the mode of solidification. Dissert. Abstr.

N70-25032# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
ENVIRONMENTALLY INDUCED CRACKING OF ZIRCONIUM ALLOYS. PART 1: THE TOPOGRAPHY OF STRESS CORROSION CRACKING IN METHANOLIC SOLUTIONS
B. Cox Jan. 1970 26 p refs
(AECL-3551) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $1.00

A comparison between the stress corrosion cracking of zirconium alloys (in methanol, methanol/iodine and methanol/HCl solutions) and the published behavior of titanium in the same solutions shows a close similarity. The fracture surfaces produced in these solutions have been examined on the scanning electron microscope, and specimen sections have been examined metallographically. In methanol/iodine solutions zirconium alloy stress-corrosion cracks propagate almost completely intergranularly. In methanol/HCl solutions, however, stress-cracking may be partially transgranular. Intergranular penetration provides the initiation step, in this instance also, and for specimens lowly stressed the fracture surface is predominantly intergranular. The degree of transgranular cracking appears to be related to the rate of crack propagation rather than to the absolute stress level in the specimens, or to their oxygen content. Author

N70-25038 Carnegie-Mellon Univ., Pittsburgh, Pa.
THE MIGRATIONAL CHARACTERISTICS OF THE CUSP-ORIENTED alpha/kappa INTERFACE IN THE Cu-Si SYSTEM
John-Kai Tien (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-15749

The migrational characteristics of coherent boundaries in the two phase, region of the copper-silicon system were studied as a function of the driving force and an atomistic model based on dislocation motion was shown to describe the behavior. A new resistometric technique is introduced for studying interface mobility in solids. Basically, this technique involves rapidly changing the specimen temperature by a few degrees followed by observation of the specimen resistance as a function of time. The specimen temperature can be increased by pulse heating or decreased by thermal relaxation, and, by using a range of temperature changes with a constant reaction temperature, the influence of supersaturation or thermodynamic driving force can be studied. The resistance of the specimen is determined by making it one arm of a highly sensitive, Kelvin bridge which has a copper compensator as the opposite arm serving to nullify spurious resistance changes due to temperature fluctuations. Dissert. Abstr.

N70-25151# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS, VOLUME 3, PART 4: MECHANICAL PROPERTIES. PART 5: GENERAL DISCUSSION
B. L. Eyre, ed. Dec. 1968 258 p refs Presented at a Symposium, Harwell, Engl., 4-12 Jul. 1968
(AERE-R-5944(Vol-3); CONF-680715-Vol-3) Avail: CFSTI; UK 34s

Critical resolved shear stress over a range of temperature was investigated using Ta alloys and Nb alloys. Results of studies on commercially pure (99.98 percent) polycrystalline tungsten irradiated at reactor ambient temperatures at different fast neutron fluences show that three prominent point defect recovery stages occur above room temperature at approximately 0.15, 0.22, and 0.31 metal melting temperature. A theory of the flow stress of cubic crystals containing low symmetry point defects or small point defect clusters is outlined. The temperature dependence of the yield stress of various bcc metals such as tungsten, molybdenum, tantalum, niobium, and potassium was analyzed assuming that point defects with tetragonal symmetry act as obstacles to dislocation motion. Discussions and summaries are presented on kinetics of point defect diffusion to dislocations, behavior of point defects at dislocations, diffusion of point defects along dislocation lines, cluster formation on dislocations, interactions of point defects with loops, and radioinduced creep in fissile material. NSA

N70-25157# United Kingdom Atomic Energy Authority, Harwell (England).
THE INTERACTIONS BETWEEN DISLOCATIONS AND POINT DEFECTS, VOLUME 2, PART 3: DISLOCATION CLIMB
B. L. Eyre, ed. Dec. 1968 286 p refs Proc. of a Symp. held at Harwell, Engl., 4-12 Jul. 1968
(AERE-R-5944-Vol-2; CONF-680715-Vol-2) Avail: HMSO £2 4s; BIS$7.92; CFSTI

The role of factors which determine the physical mechanisms in high temperature creep of metals and dilute solid solution alloys, and particularly, the role of climb is discussed. Climb models are reviewed; these models adequately represent the activation energies and stress laws for creep but fail to represent the nature, formation, and recovery of the substructure. Experimental observations of climb processes are reported in aluminum and aluminum-magnesium alloys as a result of direct observation using thin foil transmission electron microscopy. The kinetics of climb during the annealing shrinkage of prismatic and faulted loops in aluminum support a vacancy diffusion mechanism. In a study of dislocation climb deformation of Be, it was found that single crystals of Be compressed along the C axis deform by transport of matter between vacancy sources. Observations of irradiation growth and irradiation enhanced creep in fcc and bcc metals is also reported. Other mechanisms described are defects in Al single crystals, effects of oxidation on dislocation climb, specimen damage by electron microscopes, and diffusion along dislocations. M.H.E.

N70-25190*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRESS CORROSION CRACKING EVALUATION OF SEVERAL FERROUS AND NICKEL ALLOYS
T. S. Humphries and E. E. Nelson 2 Apr. 1970 19 p refs
(NASA-TM-X-64511) Avail: CFSTI CSCL 11F

The stress corrosion cracking characteristics of H-11 steel, Hastelloy C, Inconel 718, Waspaloy, music wire, and stainless steels Arde (cryoformed) low silicon 301, AISI 303, AISI 304, Armco 21-6-9 are described. Three types of specimens (round tensile, flat tensile, and C-ring) were employed and the main test environment was alternate immersion in 3.5 percent salt solution.

The results of the test indicated that music wire, Hastelloy C, Inconel 718, Waspaloy, and stainless steels Arde 301, AISI 303, AISI 304 and Armco 21-6-9 in most forms and heat treat conditions are resistant to stress corrosion cracking in environments containing moist chlorides. However, another investigator has reported both service and laboratory stress corrosion cracking of cryoformed 301 stainless steel under different conditions. H-11 steel is susceptible to stress corrosion cracking in both moist chloride environments and semi-industrial atmospheres. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-24004*# Bureau of Mines, Spokane, Wash.
STRENGTHS OF SULFUR-BASALT CONCRETES
Lester J. Crow and Robert C. Bates Mar. 1970 25 p refs
(NASA-Order R-09-040-001)
(NASA-CR-109449; BM-RI-7349) Avail: CFSTI CSCL 11B

The value of using sulfur in bonding high strength, well graded basalt aggregates to form sulfur-basalt concretes is demonstrated. The strength of a thermoplastic sulfur-aggregate mixture depends, to a large degree, on the strength and grain-size distribution of the aggregate used. A 3-cubic-foot, electrically powered mixer with heat applied to the barrel was used to mix the sulfur and aggregate. Sulfur content of several mixtures was varied to obtain the best workability with a minimum of sulfur in excess of that necessary to fill the voids. The average grain sizes and grain size distributions were also varied to determine their effects on strength. Unconfined compression tests of 6- by 12-inch cylinders yielded average strengths of 3,348 psi to 10,398 psi. The highest strength single cylinder was 10,717 psi. The cylinders were tested from 24 hours to 6 days after pouring; after 24 hours the rise in strength was very slight. It appears that sulfur can be a useful construction material. At elevated temperatures 50 to 100 C, significant losses of sulfur by sublimation can be expected. At lower temperatures the losses are not significant. Author

N70-24059# IIT Research Inst., Chicago, Ill.
FIBER OPTICS WITH EXTENDED ULTRAVIOLET TRANSMISSION Triannual Report, 1 May – 31 Aug. 1969
M. A. Ali, A. G. Pincus, and M. A. Schwartz Fort Monmouth, N.J. ECOM Dec. 1969 28 p *Its* Triann. Rept. No. 6
(Contract DAAB07-67-C-0542)
(AD-698489; ECOM-0542-6) Avail: CFSTI CSCL 11/2

The objective of this contract is to conduct research and development leading to the fabrication of fiber optic faceplates for cathode ray tubes with high transmission in the near and middle ultraviolet regions. During this period, compositional studies of the effects of redox oxide additives were performed. A clad glass matching the thermal expansion and softening point of the core glass was produced. Scaled-up melting of both the core and clad glasses has been initiated and the processing techniques are being optimized. Author (TAB)

N70-24100# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
MECHANICAL CHARACTERIZATION OF A NATURAL RUBBER Interim Report
Jerome M. Klosner and Alexander Segal Oct. 1969 22 p refs
(Contract DAHC04-69-C-0019)
(AD-698464; PIBAL-69-42; AROD-7448-1-E) Avail: CFSTI CSCL 11/10

Biaxial and uniaxial experiments have been conducted on a thin sheet of natural rubber, which can be assumed to be incompressible, isotropic and perfectly elastic. The strain energy function and constitutive equations have been determined, and the material is seen to be of the general Rivlin-Saunders type. Also included is a description of the biaxial testing apparatus which was designed and constructed for use in the general investigation of stress concentration in elastomers. Author (TAB)

N70-24102# Maryland Univ., College Park. Inst. for Molecular Physics.
THE GALVANOMAGNETIC PROPERTIES OF GRAPHITE IN THE TEMPERATURE RANGE 4-300 DEG K AND PRESSURE RANGE 0 – 10,000 KG/CM 2 Annual Progress Report
Ian L. Spain Oct. 1969 17 p refs
(Contract AT(40-1)-3782)
(ORO-3782-1-A) Avail: CFSTI

Experimental results at 77 to 300 K are summarized briefly, and problems with the apparatus are described. Chemical analysis of the graphite crystals is reported. Theoretical calculations of the galvano- and thermomagnetic tensor coefficients of graphite from energy band models are in progress. NSA

N70-24213# Los Alamos Scientific Lab., N. Mex.
THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC VANADIUM AND TITANIUM CARBIDES
V. I. Alekseev et al 14 Nov. 1969 9 p refs Transl. into ENGLISH from the Russian
(LA-4212-TR) Avail: CFSTI

The dependence of carbon activity on composition and temperature in nonstoichiometric vanadium and titanium carbides was determined experimentally at 973 to 1223 K. Carbon activity was determined by the circulation method of investigating gaseous equilibria (with the carbide) in the H2-CH4-C system. It is found that when the at.%C/at.%Me ratio changes within the homogeneity region (Me refers to metal in this context), the carbon activity changes by more than two orders of magnitude. In vanadium carbide at 1000 K, for example, the carbon activity increases by a factor of 500 when the at.%C/at.%V ratio changes from 0.6 to 0.83. An equation was derived describing the composition-dependence of carbon activity and from analysis of the temperature dependences, it was established that the change in carbon activity within the homogeneity region of the vanadium and titanium carbides was due to the effect of both enthalpy and entropy terms. Author (NSA)

N70-24225# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICAL CHEMISTRY AND MECHANICS OF ORIENTED GLASS-REINFORCED PLASTICS SELECTED ARTICLES FROM AN USSR. INSTITUTE OF CHEMICAL PHYSICS. REINFORCED PLASTICS LABORATORY
L. M. Brusentsova et al 7 Aug. 1969 32 p refs Transl. into ENGLISH from the publ. "Fiziko-Khimiya i Mekhaniku Oriyentirovannykh Stekloplastikov", Moscow, Izd. Nauka, 1967 p 43 – 48, 90 – 94, and 101 – 110
(AD-699225; FTD-HT-23-543-68) Avail: CFSTI CSCL 11/9

Contents: New types of polymer binders for production of glass fiber reinforced plastics; Modification of the adhesive properties of polymer fibers by grafting of vinyl monomers; and basic questions of the mechanics of monolithic oriented glass-reinforced plastics. TAB

N70-24239# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE EFFECTIVENESS OF COOLING A SHELL-TYPE GAS-TURBINE BLADE WITH A THERMAL INSULATION COATING

Ya. I. Shnee et al. 21 Aug. 1969. 17 p. refs. Transl. into ENGLISH from Energeticheskoe Mashinostr. (USSR), no. 3, 1966 p 92-99
(AD-699244; FTD-HT-23-234-68) Avail: CFSTI CSCL 21/5

The cooling of turbine blades with thermal insulating coating was investigated. A preliminary study was made to determine the effect of the coating thickness and material on the cooling effectiveness of the blade, which was followed by the investigation of the blade thermal state. The method of electrothermal analogy and an electric integrator were used in the investigation. The modeling was realized on a semilimited body representing a small element of the blade. Two coatings with different thermal conductivity, 0.2 mm and 0.4 mm thick, were studied. The experimental results were correlated by the mean integral temperatures on the coating surface, on the shell surface, and at a specified depth. The results showed the significant effect of the thermal conductivity on the blade temperature field. Standard blade specimens were subjected to mechanical tests. After tensile-strength tests, the specimens were inspected visually and electrically for cracks. Author (TAB)

N70-24282# Naval Ammunition Depot, Crane, Ind. Research and Development Dept.
ZELEC AS AN ANTISTATIC, FLAME-RETARDANT ADDITIVE-PRELIMINARY INVESTIGATION
Charles A. Lipscomb and Clifford W. Muessig. 25 Aug. 1969. 16 p
(AD-699500; RDTR-154) Avail: CFSTI CSCL 13/12

Plastics, in general, are relatively poor conductors of static electricity which tends to build up on the surface. The report indicates that Zelec (a phosphorus derivative of a long chain alcohol) may be formulated with a urethane resin to give antistatic and flame-retardant properties to the foamed-in-place material. Author (TAB)

N70-24348*# Avco Corp., Lowell, Mass. Materials Sciences Dept.
DEFORMATION PROCESSES IN FORGING CERAMICS Progress Report, 19 Sep.-19 Dec. 1969
R. M. Cannon and W. H. Rhodes. 19 Dec. 1969. 22 p. refs
(Contract NASw-1914)
(NASA-CR-109398; PR-2) Avail: CFSTI CSCL 11B

The program objective is to investigate the deformation processes involved in the forging of refractory ceramic oxides. Mechanical testing involving investigation of both flow and fracture processes are presently underway. Preliminary results of a series of multiple loading, bend tests on fine-grained alumina are reported here. The mechanical results show strong strain hardening effects and an apparent Bauschinger effect. The fracture condition is suggested to depend heavily upon attaining a critical stress; some increase in the fracture stress is indicated as a result of prior strain at lower stresses. Microstructural examination of tested specimens revealed extensive evidence for grain boundary sliding. The compressive surfaces revealed more deformation features than the tensile surfaces; some of these features are suggestive of dislocation motion. Evidence of strain enhanced grain growth was presented; this may be responsible for some of the apparent strain hardening. Author

N70-24384# Grumman Aerospace Corp., Bethpage, N.Y. Materials Engineering Dept.
DETERMINATION OF PRINCIPAL PROPERTIES OF E FIBER-GLASS HIGH TEMPERATURE EPOXY LAMINATES FOR AIRCRAFT Final Report
S. J. Dastin, Lubin, J. A. Munyak, M. Rosenberg, and A. Selbodzinski. Aug. 1969. 209 p. refs
(Contract DAAA21-68-C-0404) (AD-699362) Avail: CFSTI CSCL 11/9

A test program was conducted to develop mechanical strength data on ECDE 7581 glass fabric impregnated with F161 resin. This data is to be used in the new revision of MIL-HDBK-17. The properties determined were tensile, compressive and shear strengths and stiffnesses and Poissons ratios over the temperature range of -65F to 450F. The results are presented in graphical, tabular, and summary forms. Author (TAB)

N70-24406# Royal Aircraft Establishment, Farnborough (England).
CALCULATION OF CRITICAL SURFACE TENSIONS OF POLYMERS AND SURFACE TENSIONS OF LIQUIDS FROM CHEMICAL STRUCTURE ONLY
J. H. Sewell. Oct. 1969. 24 p. refs
(RAE-TR-69211) Copyright. Avail: CFSTI

A method of calculating critical surface tensions of polymers from their chemical structure only is described. For a set of 28 polymers, the standard deviation of the differences between calculated and observed values is 5.0 dynes/cm with a mean difference of 3.5 dynes/cm. Using additive constants for calculating molar volumes, surface tensions of 24 various liquids are predicted from the parachor. The standard deviation of the differences between calculated and observed surface tension is 4.5 dynes/cm and the mean error is 2.9 dynes/cm. Cohesive energy is found to be a function of the reciprocal of molar volume. Author (ESRO)

N70-24448*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF SEVERAL HIGH TEMPERATURE GLASS SYSTEMS Quarterly Status Report, 1 Nov. 1969-31 Jan. 1970
James F. Bacon. 1 Mar. 1970. 58 p. refs
(Contract NASw-2013)
(NASA-CR-109400; J910939-1; QSR-1) Avail: CFSTI CSCL 11B

Research conducted with a glass composition, UARL 344, is reported and includes the following: (1) A study of the temperature-viscosity curve of this glass which indicates that high fiberization rates should be obtainable over approximately a 100 C range. (2) The problems arising when this glass is fiberized in a standard (glass-industry type) one hole platinum bushing which has shown that all obstacles can be overcome and has yielded another 5,000,000 ft of 0.4 mil diameter good quality glass fiber. (3) Formation of additional epoxy-glass fiber test specimens which, although still without sizing, indicate that the strength of the glass fiber cannot be less than 450,000 lbs/sq in., but do not tell us just how much greater the strength may be. (4) Additional strength measurements on pristine glass fibers of UARL 344 glass have indicated some strengths in excess of 800,000 psi. (5) Preparation of compositional variants of the basic UARL 344 glass composition has produced three compositions with slightly higher values for Young's modulus measured on bulk specimens and ten compositions with higher specific moduli. Author

N70-24505# Explosives Research and Development Establishment, Waltham Abbey (England).
CONDUCTIVE RUBBERS
B. E. Brokenbrow, B. L. Hollingsworth, and A. L. Stokoe. 19 Feb. 1969. 46 p. refs
(AD-699494; ERDE-18/R/68) Avail: CFSTI CSCL 11/10

Acetylene black was compounded into eleven rubbers, and the resulting vulcanisates were found to be highly conductive to electricity. Electrical properties, tensile strength, elongation at break, and hardness were measured; also the effects of compression, tensile strain, flexing, and shelf ageing on their electrical resistances were studied. Different proportions of acetylene black were added to natural rubber and the resulting physical properties were measured. Various other materials were added to natural rubber such as high abrasion furnace black, two special conducting furnace blacks, graphite, carbon fibres, barium ferrite, aluminium staple, copper powder, and iron powder. Properties of these filled

vulcanisates were compared with those containing acetylene black. It was found that natural rubber filled with acetylene black to the weight ratio (100:70) produced a good processable rubber with high conductivity and that similar vulcanisates of a polysulphide rubber, a fluorinated elastomer, and a synthetic polyisoprene showed even higher conductivity. The two special furnace blacks were superior to acetylene black in physical and electrical properties. The other fillers did not show high conductivity. Author (TAB)

N70-24597# General Cable Corp., Bayonne, N.J.
PRESSURE DAMS IN COMMUNICATION CABLES
J. B. Masterson Oct. 1969 18 p refs Presented at the Intern. Wire and Cable Symp., Atlantic City, N.J. 3-5 Dec. 1969
(AD-698685) Avail: CFSTI CSCL 17/2

The polyurethane compounds as used today are an improvement over the previously-used epoxy systems. They exhibit better aging properties and lower peak exotherms. Further work is necessary in the development of polyurethane damming compounds, to lower the Free TDI and to provide greater long term hydrolytic stability. Plasticizers and other materials used to modify the physical properties of the materials must not be used to the detriment of the materials ability to form a good dam. Under extreme conditions of temperature and humidity these polyurethane compounds may revert hydrolytically. Projected life based on the time to liquify is only one indicator of the long-time performance of the compound. Compounds susceptible to weight loss as a result of aging may also fail in service. The toxicity of the free isocyanate in the prepolymer is definitely hazardous to the user. Residual TDI existing after the compound has been reacted must also be considered as a potential hazard. Author (TAB)

N70-24630# Sandia Corp., Albuquerque, N.Mex.
CONVERSION OF SYNTHETIC RESINS TO AMORPHOUS CARBON
Harold A. MacKay Jul. 1969 30 p refs Sponsored by AEC
(SC-RR-68-296) Avail: CFSTI

The utilization of synthetic organic resins as binders for carbon fabrics and fibers for the preparation of composite structures has been established. The carbonization of the composite structures to all carbon compositions is relatively new and has resulted in many problems. Voids, delaminations, and blisters with severe warping are commonly observed in the carbon composite structures after carbonization. The selection of a suitable carbon fiber or fabric reinforcement is an important criterion to be considered when preparing carbon-carbon structures because the fiber must retain its identity in the composite after carbonization and not interact with the resin to form a brittle, glassy product. Author (NSA)

N70-24653*# Rensselaer Polytechnic Inst., Troy, N.Y.
ELECTRONIC AND PHYSICAL PROPERTIES OF MATERIALS
In its Mater. Res. Mar. 1970 p 58-69 (See N70-24649 11-34)
Avail: CFSTI

Thermal and electronic measurements on polymers, glasses and metals are reported. Thermally the effects of morphology on thermal conductivity are studied by two groups: one near room temperature in polyethylene, the other at low temperatures in carbon and polyethylene. Correlations between these measurements are made. Low temperature sound velocity measurements are used to determine specific heats at 0 K to correlate with calorimetric specific heat measurements at various temperatures. Dielectric loss measurements are used to determine the conduction mechanism in glasses. The Mossbauer effect is being used to detect the formation of local magnetic moments which give a minimum in the electrical resistivity of some dilute metallic alloys at low temperatures. Author

N70-24930 California Univ., Berkeley.
VERY EARLY TIME CHARACTERISTICS OF LINEAR VISCOELASTIC MATERIALS
Izak Kaya (Ph.D. Thesis) 1968 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-13922

Some procedures for the direct determination of the short time portion of creep and relaxation functions of linear viscoelastic materials were studied. The analytical bases, as well as the numerical and experimental techniques, were developed and applied to a number of polymers in an attempt to determine their extensional creep and relaxation functions. Some of the proposed methods utilize expansions valid for short times, while others are based primarily on convolutional operations. The ones requiring measurements of the same response quantity at two different locations in the medium yielded very accurate information while those which necessitated measurements of two different response quantities at the same location were not as successful. Some of the procedures were extended to a three dimensional problem whereby information can be obtained on the behaviour in shear and dilatation of linear viscoelastic materials. Dissert. Abstr.

N70-24988# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT 298.15K OF GOETHITE AND PYROPHYLLITE
E. G. King and W. W. Weller Apr. 1970 8 p refs
(BM-RI-7369) Avail: Issuing Activity

Low-temperature heat capacity determinations of the minerals goethite and pyrophyllite were made in the temperature range from 51 to 298 K. The entropies at 298.15 K were evaluated as 14.43 + or − 0.15 cal/deg mole for goethite and 56.6 + or − 0.5 cal/deg mole for pyrophyllite. The entropies of formation from the constituent oxides are −4.4 + or − 0.2 cal/deg mole for goethite and −12.3 + or − 0.6 cal/deg mole for pyrophyllite. The standard free energy of formation of goethite from its oxides is 0.16 + or − 0.20 kcal/mole. Author

N70-25005*# Martin Marietta Corp., Denver, Colo. Research Dept.
LOW ENERGY PROTON EFFECTS ON SOLAR CELL COVER GLASS MATERIALS, VOLUME 1 Final Technical Report
Malcolm A. Lillywhite Nov. 1969 24 p
(Contract NAS2-5083)
(NASA-CR-73372) Avail: CFSTI CSCL 11B

The stability of the spectral transmission in the .3 to 2.2 micron spectral region of Solar cell cover glass materials when exposed to the simulated solar wind proton environment has been evaluated. The test specimens were irradiated with 2 and 3 Kev protons separately and combined with simulated solar electromagnetic radiation. Proton fluxes were nominal 2 × 10 to the 11th power p/sq cm sec where fluences of 5 × 10 to the 17th power p/sq cm were obtained. The materials irradiated include 0211 microsheet and 7940 fused silica with and without MgF2 antireflective coatings and were tested at 140 K, 300 K and 400 K. Samples of these materials were irradiated in a clean vacuum system, intentionally contaminated with 704 diffusion pump condensate, and then placed in a clean vacuum system for irradiation. A model is presented which attempts to explain discrepancies in reported proton damage to MgF2 and is based on a contaminant film build-up on the MgF2 surface. No optical damage was observed in the spectral region specified for any material tested under a combination of test conditions. X-ray diffraction characterization showed, however, that the crystallinity of the MgF2 thin film was altered by irradiation but no optical damage correlation was possible. Author

N70-25006*# Martin Marietta Corp., Denver, Colo. Research Dept.
LOW ENERGY PROTON EFFECTS ON SOLAR CELL COVER GLASS MATERIALS, VOLUME 2: RAW DATA Final Technical Report

Malcom A. Lillywhite Nov. 1969 98 p ref
(Contract NAS2-5083)
(NASA-CR-73438) Avail: CFSTI CSCL 11B
For abstract see N70-25005

N70-25081# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Div.
ESTIMATE OF THE SURFACE ENERGIES OF SOME METAL CARBIDES
D.A. Mortimer and M. Nicholas Aug. 1969 10 p refs
(AERE-M-2247) Avail: CFSTI

Published surface energy values for several carbides were evaluated in the light of new contact angle data. Livey and Murray's values for TiC and VC were confirmed but their values for TaC and ZrC were inconsistent with the new data. Surface energy values for Cr3C2 and NbC are suggested. Author (NSA)

N70-25103# Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
EQUILIBRIUM CHEMICAL CHARACTERISTICS OF NYLON ACRYLIC ACID GRAFT COPOLYMER Technical Report, Jan. 1965 - Jul. 1968
Edward M. Healy, Alvin O. Ramsley, and Basil A. Natsios Jul. 1969 30 p refs *Its* Series No. C-PLSEL-66
(AD-699340; TR-70-3-CE) Avail: CFSTI CSCL 7/3

The radiation-grafted copolymer of acrylic acid on nylon 6,6 - a fiber with flash-resistant properties, was studied as representative of a new and useful class of textile fibers. The present report covers the first phase of research on the fundamental chemical properties of this fiber. Equilibrium characteristics are discussed and results of work on kinetics will follow. Equilibrium studies were made of rapidly-stirred suspensions of finely cut polymer fiber at several temperatures (30-60C). The acid strength of the copolymer was unexpectedly low (apparent pKa = 9), an effect attributed to a heightened polyelectrolyte effect caused by restricted mobility of the carboxyl groups. Evidence for a conformational transition of the polymer chain at about 55% ionization was shown by a discontinuity in the Henderson-Hasselbach plot of the titration curve. This was attributed to a reversible shifting of the polymer chains. Neutral electrolyte caused a distinct increase in the apparent acid strength (pKa = 5.8), and a delay in the transition to a point later in the titration (95% neutralized). No effect of temperature on the equilibrium characteristics of the copolymer was observed. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-23930# Wisconsin Univ., Madison. Mathematics Research Center.
ON A THEOREM OF ATKINSON AND SHARMA Technical Summary Report
David Ferguson Jun. 1969 13 p refs
(Grant DA-31-124-ARO(D)-462)
(AD-699017; MRC-TSR-971) Avail: CFSTI CSCL 12/1

The paper provides a simplified proof of a theorem of Atkinson and Sharma on order poised interpolation problems and, using this, to provide a partial characterization of real poised interpolation problems. TAB

N70-23944# Los Alamos Scientific Lab., N. Mex.
ON RANDOM SEQUENCES OF INTEGERS
C.J. Everett and P.R. Stein Sep. 1969 9 p refs
(Contract W-7405-eng-36)
(LA-4268) Avail: CFSTI

A single transit method of producing a random sequence of integers with a given expected average density is developed, which is simpler, faster, and more flexible than sieve devices, and admits of easy statistical analysis, being a straightforward application of the classical Poisson sequence of trials. Some results on gap distribution, and the Goldbach property, are included for their mathematical interest. For example, it is shown that almost every sequence of random primes contains an infinity of twins, and for almost every such sequence, every sufficiently large even integer is a sum of two distinct integers of the sequence. Author (NSA)

N70-23981# Texas A&M Univ., College Station.
A NEW ESTIMATION THEORY FOR SAMPLES SURVEYS, PART 2
H.O. Hartley and J.N.K. Rao 1969 22 p refs
(Contract DAHC04-69-C-0058)
(AD-698484; AROD-8049-4-M; TR-2) Avail: CFSTI CSCL 12/1

The paper is a sequel to an earlier one (AD-698 468) on the same topic. The first paper was predominantly concerned with simple random sampling (with or without replacement) from a finite population. In the present paper one is concerned with examining the relation of the findings to the more complex sampling procedures such as unequal probability sampling as well as stratified and multistage sampling. TAB

N70-23984# Princeton Univ., N.J. Dept. of Electrical Engineering.
ACCUMULATION OF ROUND-OFF ERROR IN FAST FOURIER TRANSFORMS
Toyohisa Kaneko and Bede Liu Nov. 1969 40 p refs
(Grants AF-AFOSR-1333-67; NSF GK-1439)
(AD-698769; AFOSR-69-3018TR) Avail: CFSTI CSCL 12/1

The fast Fourier transform (FFT) is an algorithm to compute the discrete Fourier coefficients with a substantial time saving over conventional methods. The finite word length used in the computer causes an error in computing the Fourier coefficients. This paper derives explicit expressions for the mean square error in the FFT when floating-point arithmetics are used. Upper and lower bounds for the total relative mean square error are given. The theoretical results is in good agreement with the actual error observed by taking the FFT of data sequences. Author (TAB)

N70-24021# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PRIOR PROBABILITY, TWO-PERSON GAMES AND INFORMATION THEORY
R.L. Kashyap Nov. 1969 53 p refs
(Contract AF-AFOSR-1776-69; GRANT NSF GK 1970)
(AD-698773; TR-EE69-44; AFOSR-69-3096TR) Avail: CFSTI CSCL 12/1

The prior probability of a certain variable B is determined using all the available deterministic knowledge such as (1) the variable B may not be observable, but only a related variable Z may be observable so that P(Z/B) is known; (2) the probability distributions that can be assumed by B are limited by the inequalities E(h sub k (B)) > or = o where h sub k (B) are known functions. The prior probability is determined by a two-person zero-sum game which deals with the gambling on the outcomes of the observable variable Z. The prior probability distribution determined in this manner is the same as that obtained by maximizing the average uncertainty associated with the variable B given that variable Z is observable. An expression will be obtained for the uncertainty function starting with a set of axioms and the expression is the same as the Shannon mutual information I(B:Z) between the variables B and Z. Author (TAB)

N70-24034# Wisconsin Univ., Madison. Mathematics Research Center.
HARMONIC MIXED BOUNDARY VALUE PROBLEM
J.R. Whiteman Jul. 1969 19 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-699005; MRC-TSR-976) Avail: CFSTI CSCL 12/1

Accurate approximations to the exact solution of a harmonic

mixed boundary value problem are derived by extending a dual series technique through the use of a conformal transformation and the method of finite-differences. Author (TAB)

N70-24035# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
TESTS OF COORDINATE INDEPENDENCE FOR A BIVARIATE SAMPLE ON A TORUS
Edward D. Rothman Dec. 1969 23 p refs
(Contract Nonr-4010(09))
(AD-699165; TR-133) Avail: CFSTI CSCL 12/1

Blum, Kiefer and Rosenblatt (1961) considered tests of coordinate independence of a bivariate sample in the plane based on the sample distribution function. In this paper the problem is considered with the plane replaced by a torus. TAB

N70-24047# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
PARTIAL PRIOR INFORMATION: SOME EMPIRICAL BAYES AND G-MINIMAX DECISION FUNCTIONS
Stephen L. George 30 Oct. 1969 188 p refs
(Contract N00014-68-A-0515)
(AD-698501; TR-48) Avail: CFSTI CSCL 12/1

If the prior probability distribution function G of the parameters in a statistical decision theory model is not completely specified then a Bayes decision function cannot be obtained. However, in many cases there may be some partial (i.e., incomplete) prior information concerning G. The types of partial prior information considered in this paper is of two kinds: (1) N past observations on the compound distribution f sub G(t) or (2) knowledge of a restrictive class G to which the unknown G is assumed to belong. When past observations are available, empirical Bayes decision functions are found which are: (1) asymptotically optimal (2) easy to apply and (3) better than some optimal non-Bayes decision function for reasonably small N. When only knowledge of the class G is assumed, G-minimax decision functions are found. In all cases, estimators for the parameters of the normal and Bernoulli processes are found using a quadratic loss function. These estimators are then compared to each other and to other well-known estimators by means of their Bayes risks and, in the empirical Bayes case, by means of their global risks for small N. Author (TAB)

N70-24053# California Univ., Berkeley. Dept. of Mathematics.
FUNCTIONS INTO BANACH SPACES, WITH APPLICATIONS TO RANDOM DIFFERENTIAL EQUATIONS Technical Report
William J. Knight Sep. 1969 139 p refs
(Contract Nonr-222(88))
(AD-698532) Avail: CFSTI CSCL 12/1

For problems concerning the existence of different types of stochastic derivatives of processes which are the solutions of ordinary differential equations, a central feature is the need for complicated measured theoretic results in probability theory. This thesis contains such results, applies them to establish the relationship between the different kinds of stochastic derivatives and where construction of various counter examples establishes the relative strength and weakness of the results. Author (TAB)

N70-24057# California Univ., Livermore. Lawrence Radiation Lab.
COMPENSATION METHOD FOR FLATNESS MEASUREMENTS
J. Kilpi et al. 1969 16 p Transl. into ENGLISH from CIRP, Ann. Int. Inst. Prod. Eng. Res. (German), v. 17, 1969 p 75/1-75/5
(UCRL-Trans-10415) Avail: CFSTI

A compensation method in accordance with the method of least squares is presented for beam comparator measurements. The rectangular measuring pattern comprising 9 points is measured along the edges, diagonals and lines going through the center, parallel to the edges. By introducing the results of the measurements into the equations derived, the compensated result is obtained. The method can also be used for other measurements from which the deviations from a straight line, corresponding to beam comparator readings, can be calculated. Author (NSA)

N70-24084# Texas Univ., Austin. Dept. of Mathematics.
SPLINES VIA OPTIMAL CONTROL
Larry L. Schumaker and O. L. Mangasarian 1969 39 p refs Prepared in cooperation with Wisconsin Univ.
(Contracts AF-AFOSR-1812-69; DA-31-124-ARO(D)-462; Grant NSF GJ-362)
(AD-698689; AFOSR-69-3121TR) Avail: CFSTI CSCL 12/1

Optimal control theorems are used to obtain results for certain constrained variational problems whose solutions may be regarded as generalized splines. Existence, uniqueness, and characterization theorems are obtained. The generalized splines subsume Lg-splines, splines satisfying inequality constraints, and splines interpolating infinite sets of data. Author (TAB)

N70-24099# California Univ., Berkeley. Operations Research Center.
PROOF OF THE LAW OF DIMINISHING RETURNS
Ronald W. Shephard Dec. 1969 51 p refs
(Contract N00014-69-A-0200-1010; Grant NSF GP-15473)
(AD-699154; ORC-69-37) Avail: CFSTI CSCL 5/3

Based on a general mathematical model of a technology, implying certain properties for the production function, weak and strong forms of a physical law of diminishing returns are derived. It is also shown that the classical forms of this law hold if the technology is homogeneous (degree one) and the production possibility sets of the technology are strictly convex, but the latter property violates an essential property of a technology, namely that these sets have bounded efficient subsets. Author (TAB)

N70-24130# Texas Univ., Austin. Electronics Research Center.
OPTIMAL ADAPTIVE ESTIMATION STRUCTURE AND PARAMETER ADAPTATION. PART 1: LINEAR MODELS
D. G. Lainiotis 5 Sep. 1969 37 p refs
(Grants AF-AFOSR-67-0766E; AF-AFOSR-1764-69)
(AD-699219; TR-74; AFOSR-69-2757TR) Avail: CFSTI CSCL 9/4

A Bayesian approach to optimal adaptive estimation with continuous as well as discrete data is presented. Both structure and parameter adaptation are considered and specific recursive adaptation algorithms are derived for gaussian process models and linear dynamics. Specifically, for the class of adaptive estimation problems with linear dynamic models and gaussian excitations, a form of the partition theorem is given that is applicable both for structure and parameter adaptation. The partition or decomposition theorem effects the partition of the essentially nonlinear estimation problem into two parts, a linear non-adaptive part consisting of ordinary Kalman estimators and a nonlinear part that incorporates the adaptive or learning nature of the adaptive estimator. In addition, simple performance measures are introduced for the on-line performance evaluation of the adaptive estimator. The on-line performance measure utilize quantities available from the adaptive estimator and hence a minimum of additional computational effort is required for evaluation. Adaptive estimators are given for filtering, prediction, as well as smoothing. Author (TAB)

N70-24162# Stanford Univ., Calif. Dept. of Statistics.
ASYMPTOTIC PROPERTIES OF THE AUTOREGRESSIVE SPECTRAL ESTIMATOR Technical Report
Ralph Eugene Kromer 15 Dec. 1969 196 p refs
(Contract Nonr-225(80))
(AD-699194; TR-13) Avail: CFSTI CSCL 12/1

The thesis is concerned with the theory of autoregressive spectral estimators for the spectrum of a normal, stationary, zero-mean time series with a sufficiently smooth, strictly positive and bounded spectral density. Author (TAB)

N70-24186*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
CONSERVATION LAWS OF LINEAR, HOMOGENEOUS SYSTEMS
J. R. Williams Washington Apr. 1970 71 p refs
(NASA-TN-D-5718; C-102) Avail: CFSTI CSCL 12A

A representation of the abstract operator for a linear, homogeneous system into a Lie group is given, which exhibits explicitly the metrics that define its conservation laws. The general nonuniform system with n degrees of freedom is shown to obey n(2) independent conservation laws, defined by metrics some or all of which depend on the space variable. While the constant metrics define grcups, the remainder define groupoids under an appropriate binary operation; the intersections of groups and groupoids define groupoids. A Kronecker sum in the system operator is shown to belong to the corresponding Lie algebra. The group representation and the corresponding Lie algebra provide an alternative means of describing the system, compared with the representation into the matricant group, with the system operator in a Lie algebra. They indicate clearly the manner in which a system is defined by its conservation laws. Uniform systems can be viewed as a limiting case, formally the same, but for which physical arguments have restricted attention to constant metrics.
Author

N70-24196# Princeton Univ., N.J. Dept. of Electrical Engineering
A NON-PARAMETRIC RECURSIVE IDENTIFICATION ALGORITHM FOR FINITE-MEMORY LINEAR SYSTEMS
Y. Bar-Shalom and S. C. Schwartz Nov. 1969 12 p refs
Presented at 7th Ann. Allerton Conf. on Circuit and System Theory, 8-10 Oct. 1969 Submitted for publication
(Grants AF-AFOSR-1333-67; NSF GK-1532)
(AD-698770; AFOSR-69-3020TR) Avail: CFSTI CSCL 12/1

The problem of identifying a linear, finite memory, discrete-time system with noisy input and output is considered. A recursive algorithm is proposed which gives asymptotically unbiased estimates of the system parameters. The procedure does not require any specific knowledge of the noise statistics, in contrast to other proposed algorithms which generally need some knowledge of the statistics in order to obtain unbiased parameter estimates.
Author (TAB)

N70-24197# Naval Ordinance Lab., White Oak, Md.
ASYMPTOTIC DISTRIBUTIONS AND SOME INTEGRAL EQUATIONS
Stuart Lee Brodsky 2 Oct. 1968 60 p refs
(Contract AF 49(638)-1384)
(AD-699141; NOLTR-69-166) Avail: CFSTI CSCL 12/1

The report describes a method for the asymptotic solution of integral equations of convolution type within the theory of distributions of Laurent Schwartz. A distributional theory of asymptotics is developed and an investigation is made of distributional convolution equations arising from integral equations with difference kernels. The results are combined to show how one can obtain asymptotic expansions for the solutions of some integral equations of this type.
Author (TAB)

N70-24214# Los Alamos Scientific Lab., N. Mex.
MATRIX DESCRIPTION OF THE FAST FOURIER TRANSFORM
David K. Kahaner Jul. 1969 26 p refs
(Contract W-7405-eng-36)
(LA-4275) Avail: CFSTI

Recently the fast Fourier transform has been described in terms of a matrix factorization. These results are derived in detail and the explicit factored form is given from which one can obtain the computer algorithm, the necessary label permutations, and the number of arithmetic operations required in the calculation.
Author (NSA)

N70-24218# Center for Naval Analyses, Arlington, Va.
OPTIMAL WHEREABOUTS SEARCH
Joseph B. Kadane 13 Jan. 1970 29 p refs *Its* Profess. Paper No. 5
(AD-699515) Avail: CFSTI CSCL 12/2

An optimal whereabouts search maximizes the probability of correctly stating, at the end of a search costing no more than some budget C, which box contains the object. The paper shows that an optimal whereabouts search never searches the box to be guessed. An algorithm is given for finding an optimal whereabouts search strategy.
Author (TAB)

N70-24228# Wisconsin Univ., Madison. Mathematics Research Center.
NUMERICAL INTEGRATION OF THE NAVIER-STOKES EQUATIONS IN TWO DIMENSIONS
S. C. R. Dennis and Gau-Zau Ghang Jul. 1969 95 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-699001; MRC-TSR-859) Avail: CFSTI CSCL 12/1

A numerical method is described for solving the two-dimensional Navier-Stokes equations. Results for steady flow past a circular cylinder for Reynolds numbers up to 100, and past an elliptic cylinder for Reynolds numbers up to 200, are given.
Author (TAB)

N70-24231# Center for Naval Analyses, Washington, D.C.
A MOMENT PROBLEM FOR ORDER STATISTICS
Joseph B. Kadane 13 Jan. 1970 16 p refs
(AD-699514; CNA-PP-4) Avail: CFSTI CSCL 12/1

Necessary and sufficient conditions are given for a triangular array of numbers to be expectations of order statistics of some non-negative random variable. Using well-know recurrence relations, the expections of all order statistics of the largest sample size, n, in the triangular array, or the expectations of the smallest of every sample size up to and including n are sufficient to determine the whole array. The former are reduced to a Stieltjes moment problem, the latter to a Hausdorff moment problem. These results are applied to show that for every sample size, there is a positive random variable with geometrically increasing expectations of order statistics with arbitrary ratio and expectation of smallest order statistic. However, only the degenerate distributions have geometrically increasing expectations of order statistics for more than one sample size, even when the ratio and mean of the smallest order statistic can depend on the sample size.
Author (TAB)

N70-24235# California Univ., Berkeley. Operations Research Center.
CONDITIONS FOR DELAY TO HAVE FINITE MOMENTS IN THE GI/G1 QUEUE
Ronald W. Wolff Sep. 1969 16 p refs
(Grants NSF GP-8695; NSF GK-1684)
(PB-186465; ORC-69-30) Avail: CFSTI CSCL 12B

For the GI/G1 queue, conditions for delay in queue to have a stationary distribution are well known. However, there is confusion and incorrect statements regarding the finiteness of moments of this distribution. The paper corrects previously published erroneous results and derives new sufficient conditions in the stationary case.
USGRDR

N70-24288# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
TESTS FOR UNIFORMITY OF A CIRCULAR DISTRIBUTION
Edward D. Rothman Nov. 1969 26 p refs
(Contract Nonr-4010(09))
(AD-699164; TR-128) Avail: CFSTI CSCL 12/1

Suppose that a sample of size n is drawn from a circular distribution. Arbitrarily establish an origin of the circle and measure distances from this origin in a clockwise direction. Let N(t,x) denote the number of observations on the arc between but not including x, to and including (x+t) and define (A sub n)(t) = (1/n) the integral from zero to one of N(t, A sub n(t))= 1/n the integral from

zero to one of (N(t,x)-nt)squared dx. Ajne (1968), proposed most powerful test for uniformity invariant under rotation of a circle against certain close alternatives rejects when (A sub n)(1/2) is large. Watson (1967), obtained the asymptotic distribution. This paper extends Watsons result to 0 < t = or < 1/2. Author (TAB)

N70-24316# Wisconsin Univ., Madison. Mathematics Research Center.
NONLINEAR HYPERBOLIC PROBLEMS: A PRIORI BOUNDS AND SOLUTION ON PREASSIGNED SETS
Marco Cirina Jan. 1969 39 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF G-6070)
(AD-699004; MRC-960) Avail: CFSTI CSCL 12/1

The problems considered are the initial value and the mixed boundary problem for a system of quasi-linear partial differential equations in two independent variables. The main result is that under appropriate conditions the classical local solutions of these problems can be extended to sets of preassigned size. Extensions of this type are useful in the control theory of hyperbolic equations. Author (TAB)

N70-24350 Minnesota Univ., Minneapolis.
TOPICS IN NONLINEAR ESTIMATION
Shing Peter Kau (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-20027

The problem of observability is reformulated as the problem of the stability of the solutions of ordinary differential equations. The concept of asymptotic observability is introduced where an explicit form of the estimator is proposed and the corresponding estimation error equation derived. The system is said to be asymptotically observable if the null solution of the error equation is asymptotically stable. It is shown that asymptotic observability is identical to the usual sense of observability. Observability through constant gain and decoupled gain estimators are discussed. The effect of random disturbances and noises on the proposed estimators are discussed. Minimum variance filter for linear observed systems is derived. A successive linearization technique is proposed to yield a first order approximate solution to the minimum variance nonlinear filters. Dissert. Abstr.

N70-24361# Rochester Univ., N.Y. Nuclear Structure Research Lab.
ERROR ESTIMATION IN NON-LINEAR LEAST SQUARES ANALYSIS OF DATA
D. Cline and P. M. S. Lesser Feb. 1970 12 p refs Supported by NSF
(UR-NSRL-27) Avail: Issuing Activity

An incorrect procedure is frequently used, particularly in the analysis of angular correlation data, for estimating errors in quantities extracted from nonlinear least squares analysis. The correct procedure is presented. Author

N70-24366# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
RELIABILITY MODELS FOR COMPONENTS WITH CORRELATED FAILURES Technical Report
Richard L. Patterson Nov. 1969 26 p refs
(Contract DAHC04-68-C-0002)
(AD-699368; TR-26) Avail: CFSTI CSCL 14/4

The paper reviews some previous explorations of the question of statistical dependence of operating components and the effects on system reliability and presents some results not previously worked out. In particular there is shown to exist a connection among three models that do not require the assumption of statistical independence of components. Under certain conditions these models can generate the same reliability prediction even though they appear to be derived under different assumptions. Author (TAB)

N70-24388 Washington Univ., Seattle.
SMOOTH EXTENSIONS AND EXTRACTIONS IN INFINITE DIMENSIONAL BANACH SPACES
Peter Lewis Renz (Ph.D. Thesis) 1969 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-20265

On separable Banach spaces, an extension theorem is proven which demonstrates linearly isomorphic complementary closed subspaces and the identity of a homomorphism. On a Banach space with an unconditional Schauder norm and base, an extraction theorem is proven which demonstrates the identity of a diffeomorphism. Both the extension and extraction mappings defined above may be obtained at the end of smooth isotopies which start from the identity mapping. Dissert. Abstr.

N70-24398 Virginia Polytechnic Inst., Blacksburg.
ON FREE AND PROJECTIVE TOPOLOGICAL GROUPS
Frederick Roger Ward (Ph.D. Thesis) 1969 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19988

This dissertation constitutes an inquiry into the field of projective topological groups, and, necessarily, includes some study of free topological groups. One of the main objectives is to determine how large the class of projective groups is. Also, the utility of the concept of projective topological group is tested by using it to define projective covers of a topological group. Background material is given. This includes the definition of projective and A-projective groups. Also, the separate definitions used by A. A. Markov and M. I. Graev for free topological groups and free Abelian topological groups are given. An example of a projective topological group is explored, and it is shown that this group is free Abelian in the sense of Graev. It is shown that all free Abelian topological groups in the sense of Graev are A-projective and that all free topological groups in the sense of Graev are projective. This enlarges the class of known projective topological groups significantly. Dissert. Abstr.

N70-24399 Johns Hopkins Univ., Baltimore, Md.
DICHOTOMIES FOR LINEAR FUNCTIONAL-DIFFERENTIAL EQUATIONS
Giampiero Pecelli (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-21077

In this paper the author studies the relationship between the admissibility of pairs of Banach spaces for a non-homogeneous linear functional-differential equation and the conditional stability of the solutions of the corresponding homogeneous equation. The results obtained are almost complete analogues of the ones known for ordinary differential equations. In particular some sufficient conditions are obtained for the existence of a dichotomy (total, total exponential, uniform) for the solutions of the homogeneous equation; some partial converse theorems are proven, giving some sufficient conditions for the admissibility of pairs for the non-homogeneous equation; a theorem on small linear perturbations is obtained. The paper ends with a short appendix sketching applications to nonlinear functional-differential equations. Dissert. Abstr.

N70-24400 Polytechnic Inst. of Brooklyn, N.Y.
ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF SYSTEMS OF DIFFERENTIAL-DIFFERENCE EQUATIONS
Gupteshwar Prasad (Ph.D. Thesis) 1969 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20359

A system of differential-difference equations is considered: U'(t) + (A sub O + A(t)) U(t) + B sub OU(t-w) = 0, where U(t) is an n-component vector, t > or = to 0 is a real variable, A sub o and B sub o are n x n constant matrices, w is a positive constant, and A(t) is an n x n matrix such that if lambda, the principal root (root with largest real part) of the corresponding characteristic equation is real and simple, then there is a solution U(t) where C is a constant n-component vector. Dissert. Abstr.

N70-24439# RAND Corp., Santa Monica, Calif.
A MONTE CARLO STUDY OF LINEAR REGRESSION ASSUMPTIONS
G. C. Sumner Oct. 1969 50 p refs
(Contract F44620-67-C-0045)
(AD-698734; RM-6105-PR) Avail: CFSTI CSCL 12/1

The report demonstrates the effects on linear regression estimates of variations in (1) the distribution of the dependent variable, (2) distribution of the independent variable, and (3) intercorrelation between independent variables. The basic approach is to premise a population model to reflect some underlying physical law or structural relationship, assign numerical values to parameters, and then introduce violations of the classical assumptions that might be typical in cost estimation problems. From the various cases thus constructed, samples are generated by computer in Monte Carlo fashion. This empirical study tests the sensitivity (in terms of bias and sampling variability) of regression coefficients and common statistical measures of reliability. TAB

N70-24440# RAND Corp., Santa Monica, Calif.
SOURCE FUNCTIONS FOR AN ISOTROPICALLY SCATTERING ATMOSPHERE BOUNDED BY A SPECULAR REFLECTOR
J. Casti, R. Kalaba, and S. Ueno Oct. 1969 31 p refs
(Contract F44620-67-C-0045)
(AD-698736; RM-6146-PR) Avail: CFSTI CSCL 4/1

The paper presents a method for reducing the calculation of the source function for a specular reflector to the solution of a set of ordinary differential equations with known initial conditions. The basic Fredholm integral equation that these source functions satisfy is transformed into a Cauchy system with known initial conditions. To deal numerically with the differential-integral equations, the integrals appearing are approximated by finite sums. Some typical computational results are displayed for the case of a perfect specular reflector at the bottom. These are contrasted with earlier results for an atmosphere having a perfect absorber at the bottom. The accuracy of the numerical results has been considered in detail. TAB

N70-24441# RAND Corp., Santa Monica, Calif.
NOTES ON COMBINATORIAL MATHEMATICS: TRANSITIVE SUBTOURNAMENTS
Joel Spencer Nov. 1969 19 p refs
(Contract F44620-67-C-0045)
(AD-698737; RM-6156-PR) Avail: CFSTI CSCL 12/2

The report describes a round robin tournament in which each player plays one game with every other player, and each game ends in a win for one of the players. In a tournament of this type with 15 players, it is shown that some 5 players will be involved in a transitive subtournament. That is, considering only the games that the 5 players play among themselves, the players can be ranked in such a way that no upsets occur. Although the same result has been obtained by other authors using different techniques, this proof is unique in that it involves close scrutiny of the subtournament of players that have lost to one individual player. Certain families of sets of players are studied that turn out to be Steiner Triple systems on seven elements. This result disproves a conjecture of the Hungarian mathematicians P. Erdos and L. Moser. Author (TAB)

N70-24462 Colorado Univ., Boulder.
SENSITIVITY REDUCTION THROUGH REOPTIMIZATION
Frederick James Taylor (Ph.D. Thesis) 1969 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-19574

The ability to maintain an optimal solution independent of parameter variations is philosophically appealing. Unfortunately, whenever the internal system parameters change in value the system usually no longer operates in an optimal fashion. Therefore, the purpose of this research is to devise a scheme which will continually adjust its control strategy in such a manner that the control remains optimum for a set of parameter variations. To accomplish this demand upon the system the Maximum Principle will operate on a special Hamiltonian system. The special system referred to is a truncated Taylor series representation of a Hamiltonian subject to parameter variations. As a result of the optimization process, an adaptive control strategy will evolve as a derived result. However, adaptive structures are known to have some drawbacks in that they require information which is not always directly accessible. Dissert. Abstr.

N70-24465 Michigan State Univ., East Lansing.
SOME ERGODIC PROPERTIES OF MULTI-DIMENSIONAL F-EXPANSIONS
Michael Spencer Waterman (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-20951

Analog of Kuzmin's theorem for continued fractions was obtained. Rates are given at which iteration of an arbitrary function converges. These rates are utilized in proving a strong mixing condition. A central limit theorem and a law of the iterated logarithm are then obtained. In addition to a class of one-dimensional examples, the n-dimensional continued fraction (the Jacobi algorithm) as an example is given. A simple generalization of the Jacobi algorithm is discussed. Dissert. Abstr.

N70-24466 New York Univ., N.Y.
PSEUDO-TRANSLATION OPERATORS
Remi Vaillancourt (Ph.D. Thesis) 1969 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-21278

The notion of symbol is used to define pseudo-translation operators and pseudo-difference operators. Fourier-maximum symbols and pseudo-differential operators are introduced and a brief survey of the algebra and calculus of these operators is given. A parallel treatment for the class of translation operators whose symbols are bounded with respect to the Lax-Nirenberg (s,t)-maximum norm. A useful calculus and a particular form of the Lax-Nirenberg Theorem for Fourier-maximum pseudo-difference operators with homogeneous symbols of degree zero are presented. Dissert. Abstr.

N70-24464# Stevens Inst. of Tech., Hoboken, N.J.
THE IDENTIFICATION OF A CLASS OF LINEAR SYSTEMS FOR WHICH SOME A PRIORI KNOWLEDGE IS AVAILABLE
Terence James McGurn (Ph.D. Thesis) 1969 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-21295

The problem of identifying the parameters of a lumped, finite order, time invariant linear system is investigated. The parameters to be estimated are the coefficients of the numerator and denominator transfer function polynomials. A priori knowledge in the form of the degree of these polynomials is assumed available. Further a priori knowledge of the approximate or nominal system pole positions may be considered beneficial in increasing the accuracy of the coefficient estimation. The identification process performs the transformation of a finite set of measured parameters into estimates of the desired coefficients. The parameters measured are, in the presence of noise, estimates of the coefficients of an orthogonal expansion of the impulse response of the system being identified. Dissert. Abstr.

N70-24470 Mississippi Univ., University.
A MEAN REFINEMENT INTEGRAL OF A FUNCTION WITH RESPECT TO A FUNCTION PAIR
Dean Blackburn Priest (Ph.D. Thesis) 1969 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-20401

Let A denote the rectangular interval [a,c] x [b,d], and let D denote a regular subdivision of A. Suppose each of f, g, and h is a real valued function from A and d = [p,r] x [q,s] is an element of D. Let F(d) denote a mean evalustion of f over the

vertrices of d and let (g,h)(d) denote the number (g(r,q) - g(p,q))(h(p,s) - h(p,q)) - (h(r,s) - h(p,s))(g(r,s) - g(r,q)). The mean integral of f over the rectangular interval A with respect to the function pair (g,h) is defined as the refinement limit of sums of the type sigma (F(d))-((g,h)(d)) where the sum is over all d in D. If g is a function from [a,c] and h is a function from [b,d], then the integral agrees naturally with the extended mean Stieltjes integral of f over A with respect to the function mu as considered by Porcelli and others.
Dissert. Abstr.

N70-24471 Stevens Inst. of Tech., Hoboken, N.J.
MONTE CARLO QUADRATURE WITH EXACTNESS FOR POLYNOMIALS
Robert Willis Quakenbush (Ph.D.Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-21302

This dissertation is concerned with the development of a sequence, g sub n(x) of estimates of which are both "exact on the average" and exact for polynomials of certain degrees. Specifically, g sub n(x) will be exact for polynomials of degree < or = to 2n - 1. The schema is generalized to m-dimensional integrals. Via the influence function technique, an error term is developed in the one dimensional case. The variance of g sub n(x) is calculated. Finally, numerical evaluations are made for some well- and ill-behaved functions.
Dissert. Abstr.

N70-24472 Arizona State Univ., Tempe.
INDUCTIVE INVARIANTS AND DIMENSION THEORY
Joan Richardson (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-20793

This dissertation is concerned with two problems: The definition and investigation of inductive invariants on the class of all topological spaces, and the problem of characterizing dimension for locally separable metric spaces. If P is a collection of topological spaces then the small inductive invariant, Pind X, induced by P for every space X is defined as follows: Pind X -1 if and only if X is homeomorphic to a space in P; and for a non-negative integer n, Pind X < or = n provided each point of X has arbitrarily small neighborhoods U in X such that Pind (Bd U) < or = to n-1, where Bd U is the boundary of U in X. The large inductive invariant, PInd X, induced by P for every space X is defined as follows: PInd X = - 1 if and only if X is homeomorphic to a space in P; and for non-negative integers n, PInd X < or = to n provided for each closed subset C of X and each open subset U which properly contains C there is an open set V such that C $\subset$ V $\subset$ U and PInd (Bd V) < or = to n-1. Thus inductive inductive invariants arise in a natural way as a generalization of the inductive dimension. If the family P contains only the empty space, then Pind and PInd are the ordinary small and large inductive dimension functions, respectively.
Dissert. Abstr.

N70-24473 Dartmouth Coll., Hanover, N.H.
GEOMETRIC PERMUTATION REPRESENTATIONS OF FINITE SYMPLETIC, ORTHOGONAL, AND UNITARY GROUPS
Arunas Rudvalis (Ph.D. Thesis) 1969 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-21230

Discussed are certain permutation representations of symplectic, orthogonal, and unitary groups over finite fields on the isometry classes of subspaces of the associated metric vector space. Given the isometry class of the subspace W of a metric vector space V, it is shown in 2.1.7-1.1.11 that the problems encountered may be reduced to problems about metric vector spaces of dimension at most twice that of W and their corresponding groups of isometries, and a detailed analysis of the special cases where the dimension of W is one or two the latter occurring only in the symplectic case is discussed. Certain designs associated with the above permutation representations are discussed. Some apparently new results about the simple constituents of the permutation characters of the orthogonal groups over finite fields on the three isometry classes of lines are discussed.
Dissert. Abstr.

N70-24474 Stevens Inst. of Tech., Hoboken, N.J.
THE MODULAR REPRESENTATION RING OF A SEMI-DIRECT PRODUCT OF FINITE GROUPS
John Joseph Santa Pietro (Ph.D. Thesis) 1969 49 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21303

Let G be a finite group and K a field of characteristic p > 2 where p | [G:1]. The modular representation ring of G over K is generated by the KG-isomorphism classes of left-KG-modules, where addition and multiplication are given by direct sum and tensor product respectively. Denote this ring by a(G). If G = HB is a semi-direct product, where H is a cyclic normal p-Sylow subgroup and B is abelian, then the following result is proved. For an algebraically closed field K there is a ring isomorphism congruent to where B sub 1 is the kernel of the action of B on H and B sub 2 = B/B sub 1. Here HxB sub 2 is an external semi-direct product and is metacyclic since B sub 2 is cyclic. This reduces the study of the multiplicative structure of a(G) to that of the known rings a (HxB sub 2) and a(B sub 1).
Dissert. Abstr.

N70-24502 Stevens Inst. of Tech., Hoboken, N.J.
A FREE BOUNDARY VALUE PROBLEM FOR THE HEAT EQUATION WITH PRESCRIBED BOUNDARY TEMPERATURE
Thomas John McLeo (Ph.D. Thesis) 1969 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21296

The Stefan problem for the evaporation of a liquid in which the temperature on the surface is a given non constant function is discussed. The problem is reduced to an equivalent integro-differential equation and a local existence theorem and uniqueness theorem and proofs are given. This problem may be interpreted physically as the evaporation of a plane liquid surface in a gas which is confined above the liquid by a fixed impermeable membrane. This work generalizes the previous work in that the surface temperature is not necessarily constant. The method of solution is to consider the integro-differential equation as a mapping in a Banach space. The proofs then follow from well-known contraction mapping techniques.
Dissert. Abstr.

N70-24508 Columbia Univ., New York.
SPHERICAL FUNCTIONS ON FINITE GROUPS
Dennis Travis (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20193

Given a subgroup H of a finite group G, the algebra (C[G]-H of H-class functions defined on G is studied. In particular, the questions about its irreducible representations are asked. In the case that H is the trivial subgroup (consisting of the identity of the group) it is the standard situation treated by character theory. It turns out that for an arbitrary H functions in C[G]-H are constructed that will play the role of characters. These will be the spherical functions. There are a number of orthogonality relations among them, similar to the standard relations pertaining to irreducible group characters. In addition, these functions carry with them information about the restriction map from the characters of G(G*) to those of H. These questions are related to a general set of conjectures involving S-algebras. The spherical functions are introduced and the basic orthogonality relation among them is proved.
Dissert. Abstr.

N70-24510 Colorado Univ., Boulder.
CONVERGENCE OF SEQUENCES OF LINEAR FRACTIONAL TRANSFORMATIONS
Michael Mandell (Ph.D. Thesis) 1969 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No

69-19557

The convergence of sequences of linear fractional transformations generated by another sequence of linear fractional transformations is presented. After some preliminary and new results, the case is considered in which t sub n and t = lim t sub n are all elliptic and convergence criteria established in terms of the fixed points of t sub n and t. Examples are given that show that these conditions on the fixed points—although sufficient only—cannot be dispensed with altogether. The hyperbolic-loxodromic case, in which t sub n and t all are hyperbolic and/or loxodromic, was considered and its main result is included here for the sake of completeness. The methods employed throughout involve the fixed points rather than the coefficients of t sub n. Dissert. Abstr.

N70-24511 Polytechnic Inst. of Brooklyn, N.Y.

COMPUTATIONAL ASPECTS OF ASSIGNMENT PROBLEMS

Edward Peter McMahon (Ph.D. Thesis) 1969 126 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20351

Techniques are introduced which either reduce the computation time required to solve certain zero-one programming problems or reformulate the problems to allow them to be solved by efficient algorithms. A method of introducing additional decision variables is shown to reduce the computation involved in solving certain of these problems; and, when these methods are applicable, the computation time increases no faster than linearly with the number of decision variables (except in a small number of identifiable problems). Using this concept, problems of 1050 decision variables have been solved in five to seven seconds, also on a GE-635 computer. An algorithm is presented to transform an intransitive problem (which can not be efficiently solved using the functional equation approach) into a transitive problem whose solution gives the solution to the original problem. Dissert. Abstr.

N70-24529 Kansas State Univ., Manhattan.

THE NUMBER OF SOLUTIONS OF SOME SYSTEMS OF EQUATIONS OVER A GALOIS FIELD AND AN APPLICATION TO GEOMETRY

Fuangladda Riddhagni Jung (Ph.D. Thesis) 1969 77 p

Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-21130

The consideration of some problems in the theory of equations in Galois fields is discussed. The method of evaluating N (r,s,t.) (a,b,c.) is a fairly simple and direct application of finite Fourier series and Gaussian sums. This method shows that a rather involved reduction process concerned with the analogous generalization in the case of a single linear equation is unnecessary. The complete evaluation of N (r,s,t.) (a,b,c.) produces a solvability criterion for the system (A). Dissert. Abstr.

N70-24547 Houston Univ., Tex.

NUMERICAL SOLUTIONS OF DIFFUSION-TYPE EQUATIONS

John Loyd Bryan (Ph.D. Thesis) 1969 61 p

Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-21748

A method of obtaining numerical solutions of a general class of boundary-value problems governed by the two-dimensional diffusion equation is investigated. The method employs a partial discretization of independent variables to reduce the problem of partial differential equations to a sequence of related boundary-value problems governed by a system of linear second-order ordinary differential equations. The generality of the method is demonstrated by applications to example problems involving both regular and irregular boundaries with boundary conditions of a general type. Application of separation of variables techniques to obtain closed-form solutions of a certain class of problems is presented and the results are used to indicate the accuracy of the method. Dissert. Abstr.

N70-24548 Arizona State Univ., Tempe.

ON DETERMINIING A DISTRIBUTION FUNCTION KNOWN ONLY BY ITS MOMENTS AND/OR MOMENT GENERATING FUNCTION

Thomas William Hill, Jr. (Ph.D. Thesis) 1969 183 p

Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-20774

Computational aspects of the following problem was studied: Under what conditions can we obtain a representation for a probability density function or cumulative distribution function when the function is described in terms of: (1) a moment generating function, range and continuity, and/or (2) the first n moments, range, and continuity? Further, how do we actually achieve this representation in an efficient manner? A procedure is developed capable of performing the inversion for a portion of the functions for modeling systems as Semi-Markov processes. The two approaches to this problem, function representation by frequency curves and numerical transform inversion, are combined so as to utilize each in the most advantageous way. Many examples illustrating each approach and the procedure in general are worked out. Dissert. Abstr.

N70-24602 Houston Univ., Tex.

ON THE STRUCTURE OF CERTAIN MATRIX CLASSES

Darald Joe Hartfiel (Ph.D. Thesis) 1969 78 p

Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-21754

Two problems in matrix theory are considered. The first problem is concerned with the matrix equation AXB = X where A and B are n x n doubly stochastic and it is necessary to seek n x n doubly stochastic matrix solutions X. It is noted that the set of doubly stochastic matrix solutions of this equation forms a compact convex set. All doubly stochastic matrix solutions of the equation are described by specifying the vertices of this set. An example is given and some applications of this equation are shown. The second problem is concerned with nearly reducible and nearly decomposable matrices. Relationships between nearly reducible matrices, nearly decomposable matrices and graph theory are shown. In particular, thorugh graph theory, it is shown that nearly reducible and nearly decomposable matrices have a simple structural form. Problems of constructing nearly reducible and nearly decomposable matrices from nearly reducible and nearly decomposable matrices of lower dimension are also discussed. Dissert. Abstr.

N70-24606 Ohio State Univ., Columbus.

CLIFFORD ALGEBRAS, INNER PRODUCTS AND SPINORS

Konrad John Heuvers (Ph.D. Thesis) 1969 95 p

Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-22146

A survey is made of the theory of Clifford algebras and spinors. Starting from a world space, a Clifford algebra is constructed, and then spinors arise as elements of a representation space. The various underlying assumptions are then examined. It is proved that starting from four axioms there are essentially, just three types of inner products: symmetric, Hermitian, and anti-symmetric. Isometries of the three types of inner products are investigated. Certain special isometries are studied, and then it is proved that for symmetric and Hermitian inner products a general isometry is the product of a certain number of special isometries. It is shown that symmetric and Hermitian inner products can be related by means of a conjugate operator. Finally, it is proved that there are essentially just two types of associative algebras generated by a symmetric or Hermitian inner product. In case the inner product is symmetric there is a formula for its isometries in each of the algebras, but if the inner product is Hermitian there are no such formulas. Dissert. Abstr.

N70-24644 Tulane Univ., New Orleans, La.

PARTIALLY ORDERED VECTOR SPACES AND OPERATOR ALGEBRAS

John Winston Bunce (Ph.D. Thesis) 1969 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20464

The ordered Banach space structure of JC-algebras (norm-closed Jordan algebras of self-adjoint operators on a Hilbert space) is discussed. It is shown that there is a bijection between the norm-closed Jordan ideals of a JC-algebra and the weak*-closed invariant faces of the state space. This is used to prove that a JC-algebra is a smooth ordered vector space. These results are used to study Jordan homomorphisms between JC-algebras. Some results on simplex spaces (ordered Banach spaces whose duals are L-spaces) are included. The main result is a characterization of the continuous functions on the maximal ideal space of a simplex space. Multiplicative linear functionals on singly generated C*-algebras are discussed. It is proved that the C*-algebra generated by a hypo-normal operator (an operator A such that $AA^* < or = to A^*A$) has an ample supply of multiplicative linear functionals. Dissert. Abstr.

N70-24858# System Development Corp., Santa Monica, Calif.
ON THE OPTIMAL SMOOTHING OF PIECEWISE CONTINUOUS FUNCTIONS
Marvin Blum 12 Nov. 1969 31 p refs
(AD-699217; SDC-SP-3445) Avail: CFSTI CSCL 12/1

Noisy observations on a piecewise continuous function f(t) are made at a set of sample points. The function f(t) is assumed to be represented by a linear function of unknown parameters x sub ij in the ith interval or stage. Besides the continuity condition, other linear constraints such as continuity of derivatives may be imposed at the points of discontinuity. In this paper the optimum estimate in the sense of the minimum variance unbiased estimate or best linear unbiased estimate is obtained based on processing all the data over all stages in a batch. This solution known as the classical solution is compared with a stagewise solution which has operational and computation advantages. Both estimators are unbiased. A necessary and sufficient condition under which the two estimators have equal covariance matrices is demonstrated. Author (TAB)

N70-24701 Colorado Univ., Boulder.
SOME ADDITIONAL PROPERTIES OF T-FRACTIONS
Thomas Hutton Jefferson, Jr. (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-19546

Certain properties of T-fractions and continued fractions are discussed. The concepts of correspondence at 0, correspondence at infinity, and strong correspondence at infinity of a T-fraction to a series in integral powers of z are introduced. Results on correspondence following from the form of the denominator of the n'th approximant of the T-fraction are given, and the class, beta, of series corresponding strongly at infinity to a T-fraction is specified. Dissert. Abstr.

N70-24722 Kansas Univ., Lawrence.
DEVELOPABLE SPACES AND p-SPACES
David Elmer Kullman (Ph.D. Thesis) 1969 36 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21542

A summary of some known results about developable spaces and p-spaces is presented. The notions of p-space, developable space, and G sub delta-diagonal are characterized in terms of relations, rather than covers. It is proved that a completely regular space is developable if and only if it is a strict p-space with a G sub delta diagonal. This theorem leads to a number of corollaries whose proofs are made easier in light of this theorem. These results include: (1) A metacompact p-space with a G sub delta-diagonal has a sigma-point finite development. (2) A space is metrizable if and only if it is a paracompact p-space with a G sub delta-diagonal. (3) A space is metrizable if and only if it is a stratifiable p-space. Dissert. Abstr.

N70-24786# Washington Univ., Seattle.
THE QUASI-ENDOMORPHISM ALGEBRA OF A TORSION FREE ABELIAN GROUP
Eugene F. Cornelius, Jr. (Ph.D. Thesis) 1969 47 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20215

Theorems are obtained for quasi-separable groups, which are analogous to results about separable groups: for example, every pure subgroup of finite rank in G is a quasi-summand of G if and only if G is the direct sum of a divisible group and a reduced quasi-separable group with linearly ordered type set. This study of quasi-separable groups gives insight into separable ones. A countable group G is homogeneous and completely decomposable if and only if QE(G) is dense in L(V); thus a countable, homogeneous quasi-separable group is completely decomposable. A homogeneous quasi-separable group G is separable if and only if for any pair of elements a and b of suitable heights, some endomorphism of G maps a to b. Dissert. Abstr.

N70-24787 Michigan State Univ., East Lansing.
H-AUTOMORPHISMS
James Russell Weaver (Ph.D. Thesis) 1969 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-20952

The existence of an H-automorphism for H,a subgroup of group G, was used to determine if the group factors into the product of two proper subgroups. The structure of a group containing certain subgroups, H, which are Gamma(G:H)-closed in G was considered. Dissert. Abstr.

N70-24789 Minnesota Univ., Minneapolis.
ASYMPTOTIC DISTRIBUTION OF EIGENVALUES FOR A BOUNDARY VALUE PROBLEM
Laurence Weinberg (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-20068

Eigenvalue problems naturally arising in the investigation of wave phenomena are considered. It is assumed that p(x) is a real analytic function and possesses an even finite number of simple real zeros. An equivalent integral equation is considered to prove the existence of two solutions for a differential equation having known interval asymptotic representations. A theorem is obtained to denote almost all eigenvalue problems. Dissert. Abstr.

N70-24817 Washington Univ., Seattle.
SETS OF UNIQUENESS AND MULTIPLICITY ON THE INFINITE PRODUCT OF COMPACT TOPOLOGICAL GROUPS
John Edward Coury (Ph.D. Thesis) 1969 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-20216

The countable product of compact topological groups is considered with emphasis on the cyclic group elements. The existence of a subset for this group is demonstrated. It is shown that the coordinate functions are precisely Rademacher functions. Dissert. Abstr.

N70-24818# Los Alamos Scientific Lab., N. Mex.
EXTENSIONS OF SOME RESULTS ON SINGULAR PERTURBATION PROBLEMS WITH TURNING POINTS
Fred W. Dorr and Seymour V. Parter (Wisconsin Univ.) Oct. 1969 16 p refs
(Contract W-7405-eng-36)
(LA-4290) Avail: CFSTI

Some extensions and applications of results contained in a recent paper on singular perturbation problems for ordinary differential equations are presented. Author (NSA)

N70-24887 Kansas Univ., Lawrence.
A VARIANCE REDUCTION TECHNIQUE FOR THE CONTINUOUS RANDOM WALK SOLUTION OF LAPLACE'S EQUATION

Everett Lee Johnson (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-21537

The continuous random walk techniques reported gave errors of approximately 2 to 3 percent. Essential to the success of the continuous random walk technique is a good random noise source. The variance reduction technique developed is an application of stratified sampling. The Green's function for a region is used to divide the sample population, from which the random walks sample, into subgroups which have variances less than that of the original population. An expression is derived for the theoretical variance reduction for the continuous random walk solution to Laplace's equation in a two dimensional region. The variance reduction is confirmed experimentally for a rectangular region. Dissert. Abstr.

N70-24893 California Univ., San Diego.
ASPECTS OF CONSTRUCTIVE MEASURE AND PROBABILITY THEORY
Yuen-Kwok Chan (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19777

Two ways to look at a signed measure, namely as a function function (an integral) and as a set function (a set measure), are considered. From an integral on a locally compact metric space X we obtain subsets of X which can be assigned measures. The set measure thus arrived at is shown to be additive, continuous, and of bounded variation. Next, starting from a set measure which has these three properties we define a linear function on the space of test functions on X. This linear function is then shown to be an integral. Sample spaces for real-valued stochastic processes defined on the time interval (0, 1). By definition a stochastic process is given by the finite joint-distributions. The construction of a sample space for every process is analogous to classical treatment, except in that a sample function is defined only almost everywhere and is considered to have value c at time t only if it has value near c for most of the time near t. Dissert. Abstr.

N70-24904# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
COMPARATIVE EFFECTIVENESS OF VARIOUS CRITERIA IN THE MONTE CARLO METHOD [SRAVNITEL'NAYA EFFEKTIVNOST' RAZLICHNYKH OTSENOK V METODE MONTE-KARLO]
L. V. Maiorov and A. D. Frank-Kamenetskii 1969 100 p refs In RUSSIAN
(IAE-1791) Avail: CFSTI

General equations are obtained for the dispersion of certain estimates used in solving problems of radiation transport by the Monte-Carlo method. Also obtained are approximate velocity coherent equations which permit evaluation of errors in calculating flow with the aid of various criteria. Curves are given for comparison of criteria and selection of the optimum one in each specific case. Author (NSA)

N70-24906 Iowa State Univ. of Science and Technology, Ames.
EXISTENCE OF SOLUTIONS FOR DIFFERENTIAL EQUATIONS WITH MULTIVALUED RIGHT-HAND SIDE
Michael Lawrence Engquist (Ph.D. Thesis) 1969 49 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20638

Sufficient conditions for the existence of an absolutely continuous x(t) satisfying an equation are studied. It is shown that F(t,x) is a nonempty compact set, F is upper semicontinuous with respect to inclusion in (t,x), and there exists an integrable function k(t). The proof of existence in this case involves a generalization of Filippov's implicit function lemma. Under the above conditions on F and with a uniform boundedness assumption for solutions, continuity of the attainable set with respect to initial conditions is shown. Dissert. Abstr.

N70-24908 Pennsylvania Univ., Philadelphia.
GLOBAL PROPERTIES OF A DIFFUSION PROCESS ON A CYLINDRICAL PHASE SPACE
Leo Paul Sheporaitis (Ph.D. Thesis) 1969 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-21426

A diffusion process on a cylinder is used to study stochastic processes defining states in physical problems having angular measurements. In particular a model for a missile or satellite under the influence of aerodynamic and gravitational torques is developed as a canonical diffusion process on a cylinder; the atmospheric density uncertainty introduces the randomness into the system. Asymptotic stability properties of the system are investigated. Other global properties are investigated for systems with singularities on the cylinder and pendulum type systems. An algorithm for sample function generation is presented along with a display of sample functions for the above missile example. The examples studied, in particular the missile system, should furnish insight into the behavior of solution processes. The missile example defines parameter regions for satisfactory performance. Dissert. Abstr.

N70-24939 Michigan State Univ., East Lansing.
COLLAPSING OF SIMPLICIAL COMPLEXES CROSSED WITH THE UNIT INTERVAL
Rolland Laverne Swank (Ph.D. Thesis) 1969 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-20942

The problem of collapsing a product space LxI is considered, where L is a simplicial complex and I the unit interval. By developing the concept of a simplicial relation, LxI is collapsed onto an intermediate complex called the sewn complex. Some properties are examined of the sewn complex which show when it is collapsible. A proper fold factorization is found which insures collapsibility if the first complex of the factorization is collapsible. A second technique for collapsing the product space is introduced, which, in special cases, is related to the first method. In studying this relationship, the concept of an unfoldable star is introduced. A class of complexes possessing unfoldable stars are examined for L in this class, LxI is always collapsible. Dissert. Abstr.

N70-24940 Clemson Univ., S.C.
INTERSECTIONS OF MAXIMAL L SUB n SETS AND THE GENERALIZED CONVEX KERNEL
Arthur Godwin Sparks (Ph.D. Thesis) 1969 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19740

The concept of an L sub n set, which is a generalization of the notion of a convex set introduced by Horn and Valentine. It is shown that every set in E sub m has maximal L sub n subsets. Furthermore, if S is a compact, simply-connected set in E2, then the intersection of its maximal L sub n subsets is an L sub n set. It is shown that the n-th order kernel of a compact, simply-connected set in E2 is the intersection of all its maximal L sub n subsets and thus is an L sub n set. It further is shown that one does not have to intersect the family of all the maximal L sub n subsets to obtain the n-th order kernel, but that any subfamily thereof which covers the set is sufficient. Dissert. Abstr.

N70-24950 Clemson Univ., S.C.
ON EMBEDDINGS OF TOPOLOGICAL SPACES IN A PRODUCT OF REAL NUMBER LINES
Harold Braun Reiter (Ph.D. Thesis) 1969 62 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-19738

The set R to the A of all real-valued functions on the set A can be endowed with several algebraic and analytic structures. For example, R to the A may be considered as a (topological) group under coordinate-wise addition or as a real (topological) vector space (with the product topology). By restricting A to be finite or countable, one obtains a complete normable space or a

complete separable metrizable non-normable space respectively (in the product topology). Of course, R to the A may be considered as a uniform space (with the product uniformity). Thus one may ask for a characterization of the closed subsets of R to the A, with A finite, countable or arbitrary, or of the uniform subspaces of R to the A. The answers to these two questions occupy a major portion of the work. Specifically, theorems are proved. Dissert. Abstr.

N70-24971# France. Ministere de l'Air, Paris.
INTEGRAL AND ELLIPTIC FUNCTIONS WITH APPLICATIONS. PART 1: THE REAL DOMAIN [INTEGRALES ET FONCTIONS ELLIPTIQUES EN VUE DES APPLICATIONS. PREMIERE PARTIE: DOMAINE REEL]
Rene Cazenave 1969 381 p refs In FRENCH
(Rept-452) Avail: CFSTI

The extension of the elliptical integral theories of Legendre and Jacobi is considered. Definitions, inversion of elliptic Jacobi functions, and geometric representations are calculated. Transl. by J.M.C.

N70-24973 Princeton Univ., N.J.
GENERALIZED FEYNMAN AMPLITUDES
Eugene Richard Speer (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-18189

Renormalization in the context of Lagrangian quantum field theory is reviewed, with emphasis on two points: (1) the Bogoliubov-Parasiuk definition of the renormalized Feynman amplitude of an arbitrary Feynman graph, including some generalizations of the rigorous work of Hepp, and (2) a discussion of the implementation of the renormalization by counterterms in an arbitrary interaction Lagrangian. A new quantity called a generalized Feynman amplitude is then defined. It depends analytically on complex parameters, and these analytic properties may be used to define normalized Feynman amplitudes in a new way; the method is shown to be equivalent to that of Bogoliubov, Parasiuk, and Happ. The generalized Feynman amplitude depends on other parameters also; when these take on certain values, it is equal to the Feynman amplitude for various graphs. Dissert. Abstr.

N70-24993 California Univ., Los Angeles.
GREEN'S LINES AND HD-FUNCTIONS IN RIEMANNIAN SPACES
I-Hsiung Lin (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19501

Let R be a noncompact Riemannian space with Royden's compactification R*, Royden's boundary Gamma, harmonic boundary Delta, and a harmonic measure mu on Delta. A harmonic kernel K(x,p) is first constructed on R X Gamma, and a monotonically completed class and a family U(Delta) of functions on Delta are associated with HD(R). Corresponding to the monotonically completed class, a class of Riemannian spaces is introduced. Dissert. Abstr.

N70-25006 Drexel Inst. of Tech., Philadelphia, Pa.
TIME-OPTIMAL CONTROL OF LINEAR DYNAMICAL SYSTEMS WITH SIMULTANEOUS AMPLITUDE AND FUEL CONSTRAINTS ON THE INPUT
Joseph Persichetti (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-19682

Computational algorithms are developed to generate the amplitude constrained minimum p-norm control and the time optimal control for a linear dynamical system with simultaneous amplitude and p-norm constraints on the input. In the process of developing these algorithms, the corresponding optimization problems are solved using a functional analysis (nonvariational) approach. The solution is carried out for time variant systems with multidimensional inputs, with particular emphasis given to the case when p = 1. These results are used to synthesize a computational algorithm which does not require a good initial estimate to converge. In fact, under the hypothesis of fuel-normality, convergence is guaranteed, regardless of the estimate with which the iteration is initiated. Several examples are considered, including a problem involving a time variant system with a multidimensional input. Dissert. Abstr.

N70-25017 Colorado Univ., Boulder.
A NEW CLASSIFICATION OF TERNARY QUADRATIC FORMS
William Charles Ramaley (Ph.D. Thesis) 1969 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-19565

The ternary quadratic form is investigated. An equation exists which by using the known result that an isometry of a ternary form can be expressed as the product of no more than three reflections. Products of two reflections are all that need be considered. Reflections of the desired kind are constructed and shown to exist. Dissert. Abstr.

N70-25020 Pennsylvania Univ., Philadelphia.
CONNECTIONS ON SEMI-SIMPLE LIE GROUPS
Robert Edward Beck (Ph.D. Thesis) 1969 38 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21321

The plus and minus connections of Cartan and Schouten, which exist on any Lie group, have the following three properties: 1) the connection is left invariant; 2) the curvature of the connection is zero; and 3) the set of maximal geodesics through the identity of the Lie group is equal to the set of one-parameter subgroups of the Lie group. The problem is to find all the connections on a real semi-simple Lie group which have the above three properties. Using the techniques of Helgason, the problem can be restated in terms of Lie algebras: find all skew-symmetric representations of a real semi-simple Lie algebra on itself. To solve the latter problem, general properties of skew-symmetric representations are studied first. Then by using computational methods of representation theory, the skew-symmetric representations of a complex simple Lie algebra can be determined. With standard techniques of representation theory these results can first be extended to complex semi-simple Lie algebras and then to real semi-simple Lie algebras. Dissert. Abstr.

N70-25022 Tulane Univ., New Orleans, La.
DERIVING CHARACTERIZATIONS OF TWO-MANIFOLDS USING BRICK PARTITIONINGS
Richard Alan Slocum (Ph.D. Thesis) 1969 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20504

It is shown that if M is a Peano space with no local cut points and S is a subset of M which is a Peano continuum with no local cut points, is the closure of some domain in M, has connected complement in M and contains a point x such that every simple closed curve in S not passing through x separates M, then S is a closed 2-cell, a 2-sphere, or an annulus. This generalization allows us to weaken the hypothesis of Young's characterization of 2-manifolds by proving that if M is a Peano space with no local cut points and for x in M there is a neighborhood U of x such that every simple closed curve in U not passing through x separates M, then M is a 2-manifold. It is also shown that if M is a Peano space with no local cut points and there is an integer m > or = 1 such that every disjoint union of m simple closed curve separates M, then M is a 2-manifold. Dissert. Abstr.

N70-25023 Pennsylvania Univ., Philadelphia.
CONTRIBUTIONS TO THE FOUNDATIONS OF MEASUREMENT ANALYSIS
Tony Edward Smith (Ph.D. Thesis) 1969 234 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-21430

The model-theoretic approach to measurement analysis which has been developed by Suppes and his associates is considered. In this approach, the results of measurement are characterized in terms of the algebraic notion of a relational system, and the symbolic representation of these measurements is characterized as a homomorphic embedding of relational systems. These representations are in turn taken to define the models for a theory of measurement within the first-order predicate calculus. Unfortunately, this restriction to first-order languages severely limits the kinds of statements we can make about measurement, and hence the scope of our measurement analyses. However, developments in Model Theory by Robinson and others have shown that we can extend these languages to a class of higher-order languages in such a way that all the standard concepts of mathematical analysis can be axionatized in a consistent manner. Dissert. Abstr.

N70-25024 California Univ., Los Angeles.
THE CHOQUET BOUNDARY AND THE PEAK POINTS FOR A NONCLOSED SUBSPACE OF C(S)
Tae-Geun Cho (Ph.D. Thesis) 1969 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19492

If a nonclosed subspace X is generated by a weakly compact convex subset, then peak points are dense in the Choquet boundary for X. A necessary and sufficient condition for a peak point for a subspace X is proven. A continuous linear image of a separable Banach space is generated by a weakly compact convex subset. Some properties of a peak point for a uniformly closed subspace X of C(S) are reviewed. Dissert. Abstr.

N70-25025 Brandeis Univ., Waltham, Mass.
K3 SURFACES
Daniel Comenetz (Ph.D. Thesis) 1969 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20719

An algebraic surface V is called a K3 surface if V is regular and the canonical class on V reduces to zero. For instance, a nonsingular quartic surface in IP cu is a K3 surface; if the 16 double points on the classical Kummer's surface are resolved; the result is a K3 surface. There exist K3 surfaces on which there is a pencil of elliptic curves and a nonsingular rational curve. Dissert. Abstr.

N70-25026 Carnegie-Mellon Univ., Pittsburgh, Pa.
EXTENSIONS OF PSEUDOMETRICS AND LINEAR SPACE-VALUED FUNCTIONS
Linnea Imler (Ph.D. Thesis) 1969 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-19098

The extension of continuous pseudometrics and functions taking their values in a topological vector space are dealt with. Let F be a subspace of a topological space X and let gamma be an infinite cardinal. Then F is P-gamma imbedded in X if and only if every gamma-separable continuous pseudometric on F extends to a gamma-separable continuous pseudometric on X; F is P-embedded in X if and only if every continuous psuedometric on F extends to a continuous pseudometric on X. It is known that the notion of P-imbedding can be used to characterize normal spaces. The main theorem characterizes P-gamma imbedding in terms of the extension of functions having values in a complete, convex, metrizable subset of a locally convex topological vector space. Results characterizing P, C, and C^*-imbedding are obtained as corollaries. It is shown that every uniformly continuous function from a uniform subspace into a complete, metrizable locally convex topological vector space extends to a continuous function on the whole space. Dissert. Abstr.

N70-25027 Tulane Univ., New Orleans, La.
BOUNDED HOLOMORPHIC FUNCTIONS OF SEVERAL COMPLEX VARIABLES
Dong Sie Kim (Ph.D. Thesis) 1969 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20489

Let (X, A) be a ringed space and D, a subset of X, be a region. Let B(D) be the algebra of bounded A-holomorphic functions on D. A theorem is given which defines conditions where there exists a function f as an element of B(D) for which every boundary point of D is a singularity. If B(D) has a function which is a singular function at every boundary point of D, D is called a region of bounded holomorphy. Other conditions are given in which D would be called a region of bounded existence. It is shown that with the local established characterization of bounded holomorphy region, a rich collection of bounded holomorphy regions can be found in the n-dimensional complex space. The envelope of bounded holomorphy is described and application is made to cases of a Riemann domain and a Stein manifold of bounded type. Dissert. Abstr.

N70-25028 Michigan State Univ., East Lansing.
THE n-SEGMENT PROPERTY FOR CONTINUOUS FUNCTIONS DEFINED IN THE UPPER HALF PLANE
Charles Leonard Belna (Ph.D. Thesis) 1969 44 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20823

Let f be a function from the upper half plane H into the Reimann sphere W and let p be a point on the real line R. Existing n-segments and the cluster set of f at p are defined and given as conditions where f is said to possess the n-segment property at p. It is shown that the set of such points is countable if f is a homeomorphism of H onto a Jordon domain U. Various techniques which hinge on the Lebesgue Density Theorem are used to define the following point sets; (1) those at which a continuous function has the n-segment property relative to either n or n-1 fixed directions, (2) those at which a continuous function has the n-segment property relative to n fixed points in H, and (3) those at which a continuous function has the essential-n-segment property relative to n fixed directions. Dissert. Abstr.

N70-25030 Stevens Inst. of Tech., Hoboken, N.J.
NUMERICAL INTEGRATION WITH COMPLEX EXPONENTIAL KERNELS
Meyer Mike Kaplan (Ph.D. Thesis) 1969 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-21291

The integration procedure extended is one which has a structure common to many integration procedures (Gregory's formula being a classical example). A linear change of variable results in integration over any finite interval. The evaluation of the integral using integer sample points is investigated. The sign of H sub s (O) is shown to be negative for all s, and indicates the asymptotic behavior of H sub s (O) for large s. The size of the coefficients in the error structure are examined and an asymptotic expansion for large values of s is developed. The case where lambda is complex is investigated and the integer and half-integer sample points are considered respectively. Filon's method for evaluating integrals is discussed. Numerical results and an appendix listing the computer program used to obtain the numerical results are given. Dissert. Abstr.

N70-25035 Stevens Inst. of Tech., Hoboken, N.J.
THE epsilon-ENTROPY OF BANDLIMITED FUNCTIONS
Ralph Leon Shanahan (Ph.D. Thesis) 1969 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-21304

The communication system problem of analog-to-digital conversion while keeping the quantization errors small may be formulated in the following way: the set of analog signals is taken to be the set W sub sigma(C) of all signals with bandwidth not greater than sigma and energy not greater than C; the elements in W sub sigma(C) are functions of time and they are to be measured by the metric induced from the norm where p(t) is a

weight function; and the quantization error is taken to be the metric distance between the analog function and its digital approximation. This quantization error is to be less than or equal to epsilon uniformly for all energy-constrained bandlimited functions. The problem, then, is to determine the minimum number of epsilon-balls required to cover the set W sub sigma(C). The logarithm of this number is the eta-entropy of W sub sigma(C) relative to the normed linear space W(sub sigma,p) formed with the above norm on the linear space W sub sigma of all signals with bandwidth not exceeding sigma. Dissert. Abstr.

N70-25036 California Inst. of Tech., Pasadena.
THE RIESZ SPACE STRUCTURE OF AN ABELIAN W*-ALGEBRA
Peter Gerard Dodds (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-19597

Let M be an Abelian W*-algebra of operators on a Hilbert space Hamiltonian. Let M sub o be the set of all linear, closed, densely defined transformations in Hamiltonian which commute with every unitary operator in the commutant M' of M. A well known result of R. Pallu de la Barrière states that if Phi is a normal positive linear functional on M, then Phi is of the form T yields (Tx,x) for some x in Hamiltonian, where T is in M. An elementary proof of this result is given, using only those properties which are consequences of the fact that ReM is a Dedekind complete Riesz space with plenty of normal integrals. The techniques used lead to a natural construction of the class M sub o, and an elementary proof is given of the fact that a positive self-adjoint transformation in M sub o has a unique positive square root in M sub o. It is then shown that when the algebraic operations are suitably defined, then M sub o becomes a commutative algebra. Dissert. Abstr.

N70-25037 Michigan State Univ., East Lansing.
MANIFOLDS WHICH ARE HOMOLOGY DOUBLES
J. Scott Downing (Ph.D. Thesis) 1969 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20844

The basic question considered is under what conditions a manifold contains a subset which is in some sense equivalent to its complement. Conditions are given under which closed (compact, connected, and without boundary) n-manifold M is a double. Generalizing this concept, M is a t-double (for twisted) if M contains a submanifold N which is homeomorphic to the closure of its complement. If R is a principal ideal domain, M is called an R-homology double, or simply an R-double, if there exists a compact subset A in M for which there is an isomorphism for singular homology. If A can be taken as a PL subspace of the combinatorial manifold M, then M is a PL R-double. It is shown that if M is a PL R-double then it contains a PL submanifold N of dimension n satisfying the isomorphism. The subset A or N above is called a t-half, PL R-half, etc., for M. Necessary and sufficient conditions for a manifold to be a generalized double are studied. Dissert. Abstr.

N70-25102 Kansas Univ., Kansas City.
SEMI-FREDHOLM OPERATORS IN VON NEUMANN ALGEBRAS
Michael Jerome O'Neill (Ph.D. Thesis) 1969 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-21562

A common generalization for the classical concept of Fredholm operators is sought from two schools of theory: the Cordes-Labrousse work on the class of unbounded semi-Fredholm operators and Breuer's work which incorporates bounded Fredholm operators relative to a given von Neumann algebra of Hilbert space operators. A characterization of the connected components of this space of operators is given in terms of a generalized index map. In this setting, the problem of composability of unbounded operators is considered. Dissert. Abstr.

N70-25108# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
INITIAL-VALUE METHODS FOR TWO-POINT BOUNDARY-VALUE PROBLEMS
I. H. Mufti Jun. 1969 24 p refs
(NRC-11114; MK-26) Avail: CFSTI

Apart from certain methods such as that of the Fourier series or the Chebyshev methods, the computational methods for the solution of two-point boundary-value problems can be divided into two categories — the initial-value and the boundary-value (also called the methods of finite differences). A collection of initial-value methods is presented in a coherent and somewhat general manner. For the solution of the linear two-point boundary-value problem the methods of complementary functions, of particular solutions, of adjoint equations, and of Riccati transformation are discussed; for the case of the nonlinear two-point boundary-value problem, the shooting methods and that of quasilinearization. Author

N70-25114 Maryland Univ., College Park.
EXISTENCE AND UNIQUENESS PROBLEMS FOR SOLUTIONS OF THE NON-HOMOGENEOUS CAUCHY-REMANN EQUATION AND SOME RELATED EQUATIONS
German Lemoine (Ph.D. Thesis) 1969 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-20300

The partial differential equations of u with respect to z, and their real analoques of the differential of u with respect to x are given. The boundary-values of the solutions of these equations can not be arbitrarily prescribed. If the function g defined on the boundary partial differential of omega of the domain omega is such that one of the above equations has a solution u in omega assuming the values g on partial differential of omega, then with the help of the fundamental solution of the corresponding operator, integral formulas for u in terms of f, g and the derivatives of u are found, which in the case of a homogeneous equation reduce to the classical Cauchy formulas for holomorphic functions of one or several complex variables. Dissert. Abstr.

N70-25118 Pittsburgh Univ., Pa.
THE APPROXIMATION PROPERTY FOR BANACH SPACES
Robert S. Borden (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21037

A banach space C is said to have the approximation property if one each compact set, K contained in C, the identity operator can be approximated by means of a linear operator of finite rank. If, moreover, the approximation can be made with such an operator having norm 1, C is said to have the metric approximation property. The approximation property is a topological property in that it is preserved by linear homeomorphisms, and the metric approximation property is preserved by those mappings which are also isometries. Banach spaces which have certain projection properties are considered for definition. It is shown that if a Banach space admits a Schauder basis, it has the lambda-P.A.P., and hence the A.P. Then the result is obtained that if K is a compact set in a Banach space, the linear span of K has the lambda-P.A.P. for some lambda which is $\geq$ or $=$ 1. A particular result for a Banach space D is obtained which is the dual of a Banach space C. Dissert. Abstr.

N70-25123 Kansas Univ., Kansas City.
LIE AND JORDAN STRUCTURES IN SIMPLE GRADED RINGS
Richard Lee Speers (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21582

Simple graded and prime graded rings are defined. The conditions for the existence of Lie products or commutators and their subgroups on these rings are demonstrated. Dissert. Abstr.

N70-25131 Dartmouth Coll., Hanover, N.H.
ON A GENERALIZATION OF VAN KAMPEN'S THEOREM
John Curtis Chipman (Ph.D. Thesis) 1969 38 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21225

A generalization, for simplicial complexes, of Van Kampen's theorem is investigated. A connected simplicial complex is designated as K and a cover of K consisting of connected subcomplexes of K is identified. The relationship between the fundamental group of K and the fundamental groups of the members of the cover are studied. The investigation of this relationship is carried out in terms of groups Gamma(K,A) which can be associated to any simplicial complex. Gamma(K,A) is a presented group with generators in a 1-1 correspondence with the members of the oriented 1-skeleton of K, and with relations in a 1-1 correspondence with (1) the oriented boundaries of the oriented 2-skeleton of K and (2) the members of A, a subset of the 1-skeleton of K. Dissert. Abstr.

N70-25132 Dartmouth Coll., Hanover, N.J.
OPERATIONAL CALCULUS FOR FUNCTIONS OF A GENERATOR
Martin John Broekhuysen (Ph.D. Thesis) 1969 44 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-21224

Let F belong to the convolution algebra B, let X be a complete Hausdorff locally convex topological linear space, and let a linear operator in X be the Laplace transform of F in the generator A. The Nelson and Balakrishnan definitions of the linear operator for X, a Banach space, are shown to generalize to the case of a topological linear space and to be equivalent to the Schwartz' definition of the linear operator for the general space X. The method of proof of this theorem is applied to yield a simple proof of a known characterization of the domain in X. Dissert. Abstr.

N70-25159# Akademiya Nauk URSR, Kiev.
COMPARISON OF METHODS FOR ERROR ANALYSIS
V. I. Pampuro *In its* Increasing the Precision and Automatic Elec. and Magnetic Measuring Devices 1968 p 10-14 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

Three methods are compared for analyzing errors: minimum-maximum, mean square, and probability. Depending on the method used, different values for the error on the same instrument are received. Comparing the results, it is seen that the error determined by the maximum-minimum method exceeds by more than two times the true random error. Since the correlation factor is negative, the mean-square method also exceeds the real error. In this manner the most precise method of error determination is the probability method. It is convenient to use the maximum-minimum method as an auxiliary method (for example, for orientation evaluation of the correlation factor.) Transl. by H.W.

N70-25187 Brandeis Univ., Waltham, Mass.
ADDITION FORMULAE MEROMORPHIC FUNCTIONS ON COMPLEX LIE GROUPS
Christopher Lloyd Morgan (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20732

Mesomorphic functions on domains in complex Lie groups which satisfy a certain addition formula were investigated. Specified and limiting conditions are given for elements within the addition formula, and a main theorem that classifies all functions having addition formulae on certain domains is described. Proof is shown for an extension theorem involving a commutative algebraic group and a local homomorphism which induces an isomorphism between a complex Lie group and a generated universal field. The main theorem is then proven for a mesomorphic function having addition formula on a domain around the origin of a complex plane. Dissert. Abstr.

N70-25204 Johns Hopkins Univ., Baltimore, Md.
DECOMPOSITION OF JACOBIAN VARIETIES OF ELLIPTIC MODULAR FUNCTION FIELDS AND ZETA FUNCTIONS OF HASSE TYPE ASSOCIATED WITH COMPONENTS
Toshitsune Miyake (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-21083

A complete nonsingular curve C sub chi is defined over a model of the compactification of H/Gamma sub chi (N). The J sub chi denotes the Jacobian variety of C sub chi. The decomposition of J sub chi was investigated by using the endomorphisms of J sub chi corresponding to modular correspondences of C sub chi, and the first dimensional part of the Hasse zeta-function of each component was determined by means of congruence formulas of Eichler-Shimura. Dissert. Abstr.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-23923*# Texas A&M Univ., College Station.
AN INVESTIGATION OF SMALL-SCALE MOTIONS AND THE FORECASTING OF WIND PROFILES OVER SHORT PERIODS OF TIME AT CAPE KENNEDY, FLORIDA
James R. Scoggins, M. M. Pendergast, and V. E. Moyer Washington NASA Apr. 1970 163 p refs
(Contract NAS8-21257)
(NASA-CR-1534) Avail: CFSTI CSCL 04B

Wind data provided by the FPS-16 radar/Jimisphere system (RJ) and thermodynamic data provided by the rawinsonde system (RW) were used to investigate relationships between motions of different scale. Small-scale motions were defined as the difference between a smooth profile defined to approximate the RW profile and the measured RJ profile. The statistics of these small-scale motions were related to a number of parameters including wind shear, the lapse rate of temperature, the Richardson number, and others. In addition, it was demonstrated that the small-scale motions influence greatly the Richardson number computed over layers of different thicknesses. Three of the terms representing the rate of mechanical production of turbulent kinetic energy were evaluated from the RJ data. No significant relationship was found between these terms and the small-scale motions. Author

N70-23928# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
TURBULENT DIFFUSION IN A STABLY STRATIFIED SHEAR LAYER Technical Report
Fazal H. Chaudhry and Robert N. Meroney Sep. 1969 211 p refs
(Contract DAAB07-68-C-0423)
(AD-699374; ECOM-C-0423-5; CER69-70FHC-RNM12) Avail: CFSTI CSCL 4/1

The report is concerned with the diffusion or transport of a passive substance by random motions of a turbulent fluid flow. The problem of air pollution is the most important single factor responsible for extensive study of the phenomenon of diffusion. The atmosphere is absorbing waste nearly around the clock, although its capacity to dilute and disperse the pollutants is at its lowest ebb during the night. It is this aspect of diffusion with which the report deals particularly. Author (TAB)

N70-23998# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
WIND TUNNEL STUDIES AND SIMULATION OF TURBULENT SHEAR FLOWS RELATED TO ATMOSPHERIC SCIENCE AND ASSOCIATED TECHNOLOGIES Annual Report

J. E. Cermak, J. A. Garrison, R. N. Meroney, E. C. Nickerson, and E. J. Plate 30 Jun. 1969 39 p refs
(Contract DAAB07-68-C-0423)
(AD-699373; CER69-70JEC-8; ECOM-C-0423-4) Avail: CFSTI CSCL 4/1

A summary of accomplishments is given of both an experimental and analytical nature in the following specific studies: (1) Airflow in simulated temperate and tropical forest canopy. (2) Methods of modeling diffusion tests ahead of time to design most efficient and economical field experiments. (3) Use of controlled models of field tests to extend empirical data on CB transport and diffusion. (4) Extend wind tunnel investigation to thermally stratified boundary layers and broader ranges of surface roughness. (5) Investigation of longitudinal dispersion through both shear flow and turbulence. (6) Extend the Lagrangian similarity hypothesis considering a more realistic probability function. (7) Model Dugway Proving Ground and study mean wind patterns near the ground when flow aloft is oriented SW-SE. Author (TAB)

N70-24079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICAL INSTRUMENT FOR MEASUREMENT OF ABSOLUTE ATMOSPHERIC HUMIDITY
E. E. Vyaltseva et al 4 Aug. 1969 17 p refs Transl. into ENGLISH from Tr. Inst. Prikl. Geofiz. (Leningrad), no. 10, 1967 p 60-66
(AD-699245; FTD-MT-24-505-68) Avail: CFSTI CSCL 4/2

A description is given of a device for measuring absolute atmospheric humidity. The device was developed at the State Optical Institute. The graduation of the device was made in a thermobarometric chamber at above-zero temperatures. The mechanism of the device is based on the comparison of reduction of IR radiation by water vapor in a 2.58-Mu m reform in a two-channel autocompensating optical system with various bases. Author (TAB)

N70-24118# Weather Bureau, Silver Spring, Md.
FEDERAL METEOROLOGICAL HANDBOOK NO. 1: SURFACE OBSERVATIONS
1 Jan. 1970 321 p refs Prepared in cooperation with the Dept. of Defense and the Dept. of Transportation
(AD-698884; NAVAIR-50-1D-1) Avail: SOD $2.50 CSCL 4/2

The handbook prescribes uniform instructions for standard weather observing and reporting techniques. It is intended to provide a framework within which the observer can find a system for identifying meteorological phenomena and reporting their occurrence in an understandable format. Agreements with the World Meteorological Organization, international and domestic aviation interests, and civil and military weather services provide the basis for which standards are developed. Author (TAB)

N70-24192# Naval Research Lab., Washington, D.C.
CONCURRENT MEASUREMENTS OF WATER VAPOR AND OZONE OVER WASHINGTON, D.C. Final Report, 1967-1968
H. J. Mastenbrook and D. R. Purdy 4 Nov. 1969 181 p refs
(AD-699152; NRL-6974) Avail: CFSTI CSCL 4/1

A balloon-borne instrument system has been assembled which can concurrently measure the concentrations of water vapor and ozone in the atmosphere. An observational program has provided the first collection of data of this kind for studies of atmospheric circulation. Nineteen soundings were made during 1967 and 1968 over the Washington, D.C., area, each providing vertical distributions of these two gases. The data from these soundings have been individually recorded in tables and graphs. Author (TAB)

N70-24267 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 104, NO. 3: RESULTS OF ASCENTS FROM RADIOSONDE STATION BERLIN-TEMPELHOF OF THE INSTITUTE FOR METEOROLOGY AND GEOPHYSICS OF THE FREE UNIVERSITY BERLIN FOR THE YEAR 1969, MARCH; DAILY MEASUREMENT RESULTS, MONTHLY EVALUATION AND CLIMATOLOGICAL VALUES, AS WELL AS MEASUREMENT RESULTS FROM SPECIAL ASCENTS [METEOROLOGISCHE ABHANDLUNGEN. BAND 104, HEFT 3: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1969 MAERZ; TAEGLICHE MESSRESULTATE, MONATLICHE BEARBEITUNG UND KLIMATOLOGISCHE WERTE, SOWIE MESSERGEBNISSE VON SPEZIALAUFSTIEGEN]
Eugen Pantzke, Richard Scherhag et al 1970 205 p refs In GERMAN; ENGLISH summary
Avail: CFSTI

The detailed results of the radiosonde ascents performed by the aerological station of the Institut für Meteorologie und Geophysik der Freien Universität Berlin are presented. Using these data monthly time cross sections of the averaged temperature and the zonal and meridional wind components in heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature and velocity of sound, were extracted for all standard pressure surfaces, several height levels, the tropopause and the freezing level. The data of the ozone-ascents were given in tabular and graphical form. Author

N70-24276# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 98, NO. 3: WEATHER SATELLITE OBSERVATIONS AND THEIR EVALUATION, THE EUROPEAN WEATHER PICTURE 1968 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 98, HEFT 3: WETTERSATELLITENBEOBACHTUNGEN UND IHRE AUSWERTUNG, DAS EUROPAEISCHE WETTERBILD 1968. TEIL 3, 3. VIERTELJAHR]
Ingrid Haupt, Bernhard Lindenbein et al 1969 306 p In GERMAN; ENGLISH summary
(QR-3-Pt-3) Avail: CFSTI

The results of weather satellite observations made in Berlin during the third quarter of 1968 are discussed. Part 1 reports briefly on the "Symposium on Radiation including Satellite Techniques" held in Bergen/Norway in August 1968. Emphasis is placed on lectures describing meteorological satellite instrumentation and radiation measurements. Also mentioned are the following lectures: (1) cloud cover and planetary albedo of the earth; (2) the emissivity of cloud surfaces; and (3) determination of stratospheric humidity by means of radiation measurement. Finally some comments are made on ATS-4 and ESSA 7 which have been launched during this period. Part 2 contains the daily "Daily Europaeische Wetterbild" of the same period. Part 3 gives the main orbital data of ESSA 6 as well as picture taking time and geographical coordinates of satellite pictures received. Author

N70-24278# Chicago Univ., Ill. Lab. for Atmospheric Probing.
A METHOD FOR RADAR TURBULENCE DETECTION
David Atlas and R. C. Srivastava 5 Dec. 1969 31 p refs Prepared in cooperation with IIT Res. Inst.
(TR-15) Avail: CFSTI

A method is described whereby a conventional non-Doppler radar may be used in the measurement and detection of atmospheric turbulence. The technique involves the measurement of the average echo power and the variance of the fluctuation spectrum in each of two separated pulse volumes, and corresponding measurements of echo power and variance of the detected signals in a channel representing the predetection sum of the signals from those two volumes. It is shown that the variance of the sum channel is the power-weighted sum of the variances in the independent channels plus a term dependent upon the difference in mean radial

velocity of the associated pulse volumes. Accordingly, the difference in mean radial velocity can be measured. When the spacing of the sampled volumes is adjusted to represent distance along an aircraft flight path, the measurement is a measure of the turbulence to be experienced in traversing the space between those volumes. Specific systems for accomplishing the measurement are discussed.
Author

N70-24326 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 105, NO. 2: BERLIN MEASUREMENTS; DIGITAL AND ANALOG RESULTS FROM THE MEASUREMENT REGISTRATION CENTRUM AND OTHER INSTRUMENTS FOR THE YEAR 1969 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 105, HEFT 2: BERLINER MESSWERTE; DIGITALE UND ANALOGE ERGEBNISSE DER ZENTRALEN MESSWERTREGISTRIERANLAGE UND WEITERE INSTRUMENTE FUER DAS JAHR 1969. TEIL 2, 2. VIERTELJAHR]
Richard Scherhag, Erich Wedler et al 1969 345 p In GERMAN (QR-2-Pt-2) Avail: CFSTI

Presented are digital and analog data charts from meteorological registrations obtained in Berlin. Covered is the second quarter of 1969. Transl. by G.G.

N70-24327 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 101, NO. 9: RESULTS FROM THE SYNOPTIC SERVICE FOR THE YEAR 1969; DAILY WEATHER CHARTS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC STUDIES, SEPTEMBER [METEOROLOGISCHE ABHANDLUNGEN. BAND 101, HEFT 9: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IN JAHRE 1969; TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 MB) UND KLEINERE WISSENSCHAFTLICHE SAUFSAETZE, SEPTEMBER]
Richard Scherhag et al 1969 159 p In GERMAN
Avail: CFSTI

Daily Northern Hemisphere ground-, 500-mb, and 300-mb synoptic weather maps for September, 1969, are presented. Height and temperature data are plotted on each chart and corresponding contours are drawn. Also included are specific measurements of precipitation, temperature, and radioactivity over Berlin, Germany. Brief studies on the structure of hurricanes in the upper troposphere and lower stratosphere and geometrical evaluations of satellite photos are attached. Transl. by G..G

N70-24328 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 106, NO. 3: DAILY ELEVATION CHARTS OF THE 100-mb LEVEL AND THE 50-mb LEVEL AS WELL AS MEDIAN MONTHLY CHARTS FOR THE YEAR 1969 Quarterly Report [METEOROLOGISCHE ABHANDLUNGEN. BAND 106, HEFT 3: TAEGLICHE HOEHENKARTEN DER 100-MB-FLAECHE UND DER 50-MB-FLAECHE SOWIE MONTALICHE MITTELKARTEN FUER DASJAHR 1969. TEIL 3, 3. VIERTELJAHR]
Barbara Kriester, Karin Labitzke, Renate Lenschow, Wolfgang Roeder, Richard Scherhag et al 1969 325 p In GERMAN (QR-3-Pt-3) Avail: CFSTI

Daily Northern Hemisphere topographic maps for the 100-mb and 50-mb levels are presented together with monthly medians for the third quarter of 1969. Height and temperature data plots indicate topographic increases in both levels from June to July with highest values over the land masses of North America and Eurasia.
Transl. by G.G.

N70-24329 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 101, NO. 7: RESULTS FROM THE SYNOPTIC SERVICE FOR THE YEAR 1969; DAILY WEATHER CHARTS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC STUDIES, JULY [METEOROLOGISCHE ABHANDLUNGEN. BAND 101, HEFT 7: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1969; TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb) UND KLEINERE WISSENSCHAFTLICHE AUFSHETZE, JULI]
Richard Scherhag et al 1969 256 p In GERMAN
Avail: CFSTI

Daily Northern Hemisphere ground-, 500 mb-, and 300-mb synoptic weather maps for July, 1969, are presented. Height and temperature data are plotted on each chart and corresponding contours are drawn. Also included are precipitation maps and climatological medians for Berlin, Germany. Brief studies on the development of tropical disturbances, on correlation of E-region with thunderstorms and jet streams, as well as geometrical analyses of satellite photographs are attached. Transl. by G.G.

N70-24330 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 101, NO. 8: RESULTS FROM THE SYNOPTIC SERVICE FOR THE YEAR 1969; DAILY WEATHER CHARTS (GROUND, 500 mb, 300 mb) AND BRIEF SCIENTIFIC STUDIES, AUGUST [METEOROLOGISCHE ABHANDLUNGEN. BAND 101, HEFT 8: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1969; TAEGLICHE WETTERKARTEN (BODEN, 500 MB, 300 MB) UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE, AUGUST]
Richard Scherhag et al 1969 286 p In GERMAN
Avail: CFSTI

Daily Northern Hemisphere ground-, 500-mb, and 300-mb synoptic weather maps for August, 1969, are presented. Height and temperature data are plotted on each chart and corresponding contours are drawn. Also included are precipitation and temperature maps and radioactivity measurements for Berlin, Germany. Brief studies on weather prediction and unusual radar echo dissipation on the southern shore of Sweden are attached. Transl. by G.G.

N70-24331 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 104, NO. 4: RESULTS OF ASCENTS FROM THE RADIOSONDE STATION-BERLIN-TEMPELHOF OF THE INSTITUTE FOR METEOROLOGY AND GEOPHYSICS OF THE FREE UNIVERSITY BERLIN FOR THE YEAR 1969 APRIL; DAILY MEASUREMENT RESULTS, MONTHLY EVALUATION AND CLIMATOLOGICAL VALUES, AS WELL AS MEASUREMENT RESULTS FROM SPECIAL ASCENTS [METEOROLOGISCHE ABHANDLUNGEN. BAND 104, HEFT 4: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1969 APRIL; TAEGLICHE MESSRESUCTATE, MONATLICHE BEARBEITUNG UND KLIMATOLOGISCHE WERTE, SOWIE MESSERGEBNISSE VON SPEZIALAUFSTIEGEN]
Eugen Pantzka, Richard Scherhag et al 1970 250 p In GERMAN; ENGLISH summary
Avail: CFSTI

The detailed results of the radiosonde ascents performed by the aerological station of the Institut fuer Meteorologie und Geophysik der Freien Universitaet Berlin are presented. Using these data monthly time cross sections of the averaged temperature and the zonal and meridional wind components in heights above 30 km were constructed. Extreme and mean values of the temperature, pressure, geopotential, wind data refractivity, pseudopotential temperature and velocity of sound, were extracted for all standard pressure surfaces, several height levels, the tropopause and the freezing level. The data of the ozone-ascents were given in tabular and graphical form. Author

N70-24333 World Meteorological Organization, Geneva (Switzerland).
ARTIFICIAL MODIFICATION OF CLOUDS AND PRECIPITATION
Morris Neiburger 1969 40 p refs Revised
(WMO-249-TP-137; TN-105) Copyright. Avail: Issuing Activity

The problem of weather modification is discussed and the present (end of 1968) status of the subject reviewed. In physical terms the reasons why cloud seeding may be expected to have an effect on cloud and precipitation, and why the effect on precipitation may in some instances be an increase, in others a decrease is explained. The methods by which attempts to increase precipitation may be evaluated are reviewed, and the results of a number of such attempts are presented. Author (ESRO)

N70-24353*# National Aeronautics and Space Administration, Washington, D.C.
NIMBUS-D: PRESS KIT
3 Apr. 1970 34 p
(NASA-News-Release-70-47) Avail: NASA Scientific and Technical Information Division CSCL 22B

Operational characteristics and mission objectives of the Nimbus D weather satellite are summarized. Three meteorological experiments are described which measure regions of the Earth electromagnetic spectrum globally. Scheduled for testing are: a backscatter ultraviolet spectrometer, a filter wedge spectrometer, and a selective chopper radiometer. Three improved onboard experiments using an interferometer spectrometer, a satellite infrared spectrometer, and an interrogation recording and location system are also described. Details are given for experiments which are similar to those aboard Nimbus 3. These involve a temperature humidity infrared radiometer, image dissector camera system, and a monitor of ultraviolet solar energy. S.S.

N70-24387# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
FLOW FIELD WITHIN AND ABOVE A FOREST CANOPY. TASK: STUDY OF AIRFLOW IN SIMULATED TEMPERATE AND TROPICAL FOREST CANOPIES Technical Report
W. Z. Sadeh, J. E. Cermak, and T. Kawatani Jul. 1969 71 p refs
(Contract DAAB07-68-C-0423)
(AD-699367; CER69-70WZS-JEC-TK-6; ECOM-0423-3) Avail: CFSTI CSCL 4/2

The velocity and longitudinal turbulence intensity distributions inside and above a forest canopy along its center line were investigated. For this purpose a model forest canopy was used in a meteorological wind tunnel. The results indicate that the flow may be divided into an entrance and fully developed region followed by a short adjustment distance close to canopy end. The entrance region has a decisive effect on the flow characteristics through the canopy. The velocity and turbulence inside the canopy are strongly affected by its structure. A similar qualitative variation for both velocity and turbulence was found in and above the canopy. Its influence stretches over more than 4 roughness heights above it. Generally, the results are in relatively reasonable agreement with field measurements. Investigation of the modified logarithmic law for describing the velocity profile above the canopy revealed that both flow parameters, i.e., friction velocity and roughness length, are not local constants. On the contrary, they vary drastically with height. It is suspected that this is due to the fact the assumption of constant shear stress throughout the boundary layer or significant portions of it is not satisfied. Author (TAB)

N70-24423# RAND Corp., Santa Monica, Calif.
NUMERICAL PREDICTION OF THE THERMODYNAMIC RESPONSE OF ARCTIC SEA TO ENVIRONMENTAL CHANGES
G. A. Maykut and N. Untersteiner Nov. 1969 188 p refs
(Contract F44620-67-C-0045)
(AD-698733; RM-6093-PR) Avail: CFSTI CSCL 8/12

A description is given of a one-dimensional model of Arctic sea ice. The inputs are: albedo, incoming radiation, turbulent fluxes, oceanic heat flux, ice salinity and snow accumulation. Given an arbitrary initial ice temperature field and ice thickness, the model predicts the changes in these wrought by specified environmental parameters. Annual variations in temperature and thickness are followed year by year until the pattern is stable, i.e., until either the ice disappears or the annual sequence of growth and depletion is repeated unchanged. Values predicted (using inputs based on the present climate) agree closely with field observations. Tables for 28 specified cases and annual charts for 25 are presented. In addition to showing annual growth and depletion of ice under normal and anomalous climates, results show mechanisms by which environmental conditions affect the ice. Author (TAB)

N70-24453# Chicago Univ., Ill. Lab. for Atmospheric Probing.
A DUAL WAVELENGTH RADAR HAIL DETECTOR
P. J. Eccles and David Atlas 5 Sep. 1969 64 p refs Sponsored in part by United Airlines Found. Prepared in cooperation with Illinois Inst. of Tech., Chicago
(Grant NSF GA-10639)
(TR-14) Avail: Issuing Activity

A method of hail detection which depends upon the range derivative of the ratio of average echo powers as observed by two synchronized and slaved radars of different wavelengths is presented. In the presence of rain alone this derivative is always positive and proportional to the incremental difference in attentuation at the smaller wavelengths and thus to the liquid water content provided that fluctuations in the average echo powers are ignored. The derivative goes negative, if there is a negative hail concentration gradient; that is, on the trailing edge of a hail shaft. The presence of a negative range derivative of the ratio of average echo powers is thus a nearly unequivocal hail indicator. The derivative is positive with positive hail concentration graidents; if it exceeds values expected from extreme concentrations of rain alone then this too is a hail indicator which marks the leading edge of the hail shaft. It is shown that the present method is much more sensitive than the previous one in detecting small concentrations of hail at early times in the storm's history and in greater backgrounds of nonhail precipitation echoes. Author

N70-24490# RAND Corp., Santa Monica, Calif.
ARCTIC CLOUD STATISTICS FROM AIR-CALIBRATED SURFACE WEATHER OBSERVATIONS
R. E. Huschke Oct. 1969 88 p refs
(Contract F44620-67-C-0045)
(AD-698740; RM-6273-PR) Avail: CFSTI CSCL 4/2

Statistics on the space and time distribution of clouds in the Arctic are derived from sixty-three months of surface synoptic weather data by a new technique. The technique aggregates the cloud information available in the surface synoptic weather code into eight Cloud Distribution Models that prescribe occurrence frequencies and amounts of low, middle, and high clouds, with adjustments made for middle and high clouds that exist above lower overcast conditions. The results are presented in the form of tables, graphs, and maps, and are compared with the results of previous investigation. It is concluded that this study demonstrates the value of cloud observations from aircraft to calibrate the more economical observations of clouds by surface observers and meteorological satellites. Author (TAB)

N70-24592# Environmental Science Services Administration, Boulder, Colo.
STUDIES ON THE METEOROLOGY OF ALASKA Final Report, 1 Jan. 1968 - 31 Mar. 1969
P. Putnins and Lillian C. Langdon Aug. 1969 274 p refs
(AD-699361; ECOM-95848-F) Avail: CFSTI CSCL 4/2

For the period January 1, 1945 to March 31, 1963 a calendar was outlined in which the weather situation every day was

defined according to specific weather patterns. This was obtained from the studies of weather situations for this period by investigating not only the surface maps but taken into account also, the air flow at 500 mb level. The days of this period were separated for every specific weather pattern for every month. In this report the weather elements (temperature, cloudiness, precipitation, wind, relative humidity, visibility, ceiling) are for 16 Alaska stations for every specific weather pattern and every month. From these summarizations (by weather patterns, months, years, and for the whole period) a final condensation of the results was performed for every station. The Alaska area was divided into five sections. The results are tabulated in 264 (22 x 12) tables. The Number of cases when a specific weather pattern occurred are shown on each table. Author (TAB)

N70-24601# Winzen Research, Inc., Minneapolis, Minn.
[SCIENTIFIC RESEARCH BALLOON FLIGHTS] Final Report
13 Jan. 1970 34 p
(Contract N00014-69-C-0003)
(AD-699510; WRI-1298-R) Avail: CFSTI CSCL 4/2

Launch operations, tracking techniques, recovery operations, and balloon performance analysis are presented for each flight. Detailed balloon flight parameters are documented on Skyhook Balloon Flight Information sheets. Author (TAB)

N70-24648# Chicago Univ., Ill. Dept. of Geophysical Sciences.
DEVELOPMENT OF A DRY LINE AS SHOWN BY ATS CLOUD PHOTOGRAPHY AND VERIFIED BY RADAR AND CONVENTIONAL AEROLOGICAL DATA
Dorothy L. Bradbury Nov. 1969 21 p refs
(Grants ESSA-E-41-22-69(G); ESSA-E-198-68(G))
(SMRP-RP-80) Avail: Issuing Activity

A series of applications technology satellite (ATS-III) cloud pictures shows the formation, development, and movement of a dry line. The line was detected on the ATS-III pictures long before it was observed on the radar screen and its development and motion was observed on consecutive ATS-III pictures at 14 min intervals over a period of six and one-half hours. A vertical cross-section through the dry dome shows that the isentropic layer extended up to the 500 mb surface and that the dry line was nearly vertical up to this height. The vertical distribution of the horizontal winds in the cross-section indicate jet maxima at three different levels, at and above the 600 mb surface, in addition to the low level jet located between 800 and 900 mb. The jet maxima most closely associated with the intense convective activity appears to be centered between 600 and 500 mb. Author

N70-24741# National Weather Records Center, Asheville, N.C.
CLIMATOLOGICAL SUMMARIES: VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 40: WASHINGTON, D.C., DULLES INTERNATIONAL AIRPORT Final Report
Jun. 1969 34 p
(FAA Order FA-67-WAI-129)
(AD-699182; SRDS-RD-69-22-Vol-40) Avail: CFSTI CSCL 4/2

The report consists of climatological data for Dulles International Airport, Washington, D. C. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-24777 Environmental Science Services Administration, Washington, D.C. Weather Bureau.
USE OF SEA-SURFACE TEMPERATURE IN LONG-RANGE PREDICTION
Jerome Namias *In* WMO Sea-Surface Temp. 1969 p 1-18 refs (See N70-24776 11-13)
Copyright. Avail: WMO, Geneva: Sw.Fr. 18

The problems associated with complexly coupled systems such as the ocean and the atmosphere are so difficult to solve that it is not yet possible to lay down a set of reliable forecasting rules, especially with regard to long-range forecasting, where the response time of one medium to the other is not known. In spite of these gaps in knowledge there seems to be sufficient order in large-scale air-sea interaction over periods of months and seasons, so that some qualitative use of this information can be helpful in prediction. Some large-scale and cumulative air-sea interactions which seem to have influenced wind and wave patterns over months and seasons during the 1960s are suggested. While some of these concepts are considered in the routine preparation of five-day, monthly and seasonal forecasts, they are used mainly to support or negate other indications derived purely from meteorological data. Author (ESRO)

N70-24794# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 221 2 Feb. 1970 p 6-55 refs (See N70-24792 11-34)
Avail: CFSTI

Timely problems in aviation meteorology are examined. Various aspects of wind and temperature effects on aircraft flight and air turbulence description and forecasting are evaluated. Abstracts on a wide range of meteorological data are included. J.A.M.

N70-24800*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXAMPLES OF THE USEFULNESS OF SATELLITE DATA IN GENERAL ATMOSPHERIC CIRCULATION RESEARCH. PART 2: AN ATLAS OF AVERAGE CLOUD COVER OVER THE TROPICAL PACIFIC OCEAN
Fredric A. Godshall (ESSA), Lewis J. Allison, Earl R. Kreins (USAF Environ. Tech. Appl. Center), and Guenter Warnecke Washington Dec. 1969 44 p refs
(NASA-TN-D-5831; G-958) Avail: CFSTI CSCL 04B

This atlas, based upon data from six Tiros and three ESSA satellites, depicts Pacific Ocean cloudiness from August 1962 through August 1968. The months of January, April, August, and October were selected for inclusion in the process of averaging data over areas 2 deg square from longitude 100 deg W to 130 deg E and from latitude 30 deg N to 25 deg S. Author

N70-24854# Florida State Univ., Tallahassee. Dept. of Meteorology.
AMPLITUDE VACILLATION, WAVE DISPERSION AND AVAILABLE POTENTIAL ENERGY Final Report
Richard L. Pfeffer and William W. Fowlis 1969 92 p refs
(Contract N00014-68-A-0159; Grant ESSA-E-42-67(G))
(AD-698833; Rept-69-1) Avail: CFSTI CSCL 4/1

Contents: Characteristics of amplitude vacillation in a rotating differentially heated fluid determined by a multiprobe technique; Wave dispersion in a rotating, differentially heated cylindrical annulus of fluid; Available potential energy in a quasi-geostrophic atmosphere. TAB

N70-24918# National Weather Records Center, Asheville.
CLIMATOLOGICAL SUMMARIES: VISIBILITIES BELOW 1/2 MILE AND CEILINGS BELOW 200 FEET. VOLUME 39: SYRACUSE, NEW YORK CLARENCE E. HANCOCK AIRPORT Final Report
Jun. 1969 34 p
(FAA Order FA-67-WAI-129)
(AD-699181; SRDS-RD-69-22-Vol-39) Avail: CFSTI CSCL 4/2

The report consists of climatological data for Clarence E. Hancock Airport, Syracuse, New York. Ceiling, visibility, wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Various weather and

landing system categories are tabulated, in most cases from 10 years of data, as aids for making decisions affecting landing systems and fog dissipation. Author (TAB)

N70-25090# Travelers Research Center, Inc., Hartford, Conn.
PREDICTION OF SNOWFALL DISTRIBUTION ABOUT 850-MB CYCLONES ALONG THE ATLANTIC SEABOARD
Final Report
David B. Spiegler and George E. Fisher Jan. 1970 126 p refs
(Contract ESSA-E-269 68)
(TRC-1014-380) Avail: CFSTI

Melted percipitation and snowfall data from eight winters were used to develop a snow and melted precipitation prediction model associated with 850-mb cyclones along the Atlantic Seaboard. Results indicate that the major potential for heavy snow exists in a band extending from 75 to 225 miles to the left and from 350 to about 1000 miles ahead of the 850-mb cyclone in the 12-hr period beginning 6 hours after routine upper air observation time. Application of the prediction model and synoptic climatologies of snow amounts to some storms from the 1968-69 winter season indicate they provide valuable guidance to the forecaster during periods of east coast storms. An investigation was made of the frequency of significant snow events (four inches or more in 24 hours) without the presence of 850-mb cyclones. the types of synoptic conditions leading to these events are identified and discussed. Author

N70-25112# Bureau of Meteorology, Melbourne (Australia).
RELIABILITY OF WIND DATA DETERMINED BY 277 RADAR IN AUSTRALIA
K. T. Spillane [1969] 40 p refs *Its* Meteorol. Study No. 18
Avail: CFSTI

Assessments of operational errors in elevation and azimuth measured by 277 radar are made, and combined with an assumed error in range to calculate the standard vector deviation of wind error, and wind shear errors. The errors are compared with seasonal maximum and minimum time variations, and with distance variation. Outside tropical Australia, the time scale was a maximum in summer over Central Australia and a minimum in spring over Southern Australia. In summer over Central Australia the errors are such that, on occasions, trends can only be established by comparison of soundings 12 hours apart, while in spring over the southern parts of the continent time section analysis of six-hourly winds is meaningful and offsets an open network. The scatter in any found wind due to the diffusive nature of the atmosphere is discussed, and estimates obtained in moderate and severe turbulence. The ability of various radars and methods of calculation, to detect change in wind with time or distance in seasons of extreme variability is illustrated, and provides a recommended basis of data verification in objective numerical analysis. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-23993*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR LANDMARK STUDY
Richard Strelitz 20 Mar. 1970 52 p refs
(Contract NAS7-100)
(NASA-CR-109459; JPL-760-45) Avail: CFSTI CSCL 17G

The results of a preliminary examination of the lunar surface to ascertain its suitability for landmark navigation is presented. The basic technique of landmark navigation is to triangulate the position of the observer by means of bearings to landmarks. A navigation fix is provided relative to the terrain, obviating an intermediate reference to a coordinate system. The minimum equipment for landmark navigation required aboard a remotely controlled roving vehicle is an imaging camera and a readout of its pointing angles. Author

N70-24072# Naval Research Lab., Washington, D.C.
INSTRUMENTATION OF THE NRL DIFFERENTIAL OMEGA STUDY OF APRIL 1969
W. D. Meyers Oct. 1969 19 p
(AD-699174; NRL-MR-2057) Avail: CFSTI CSCL 17/7

The Omega navigation system accuracy of one to two miles can be improved significantly in a given area by obtaining sky-wave and propagation anomaly corrections from a fixed monitor in the area. The improvement in navigational accuracy is a function of the distance from the fixed monitor, the signal-to-noise ratio, and the instrumental accuracy of the receiving equipments. As part of the differential Omega study of April 1969, two AN/WRN-2(XN-1) Omega receivers were obtained, modified, and evaluated to determine the precision with which phase measurements could be made with this type of equipment. This report describes the modifications performed and the laboratory measurements made to determine the instrumental accuracy of the equipment used in the differential Omega study. Author (TAB)

N70-24080# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROL OF MOTION DURING ATMOSPHERE REENTRY
D. E. Okhotsimiskii et al 3 Sep. 1969 19 p refs Transl. into ENGLISH from the Russian
(AD-699256; FTD-HT-23-285-69) Avail: CFSTI CSCL 22/2

Development of an algorithm to control spaceship descent into the atmosphere at parabolic velocity is presented. A multi-stage adaptive algorithm for range control on a descent section is developed. Algorithm operation simulation on a digital computer is cited and it is demonstrated that the algorithm ensures adequately accurate control of the regulation process under conditions of significant variations in atmospheric parameter distributions. Author (TAB)

N70-24250*# TRW Systems Group, Redondo Beach, Calif. Electronics Systems Lab.
PROJECT TECHNICAL REPORT MSC/TRW TASK KM-205: SLP OWS CONTROL SYSTEM DIGITAL SIMULATION REQUIREMENTS
T. J. Smith and C. F. Mc Gee 30 Jan. 1970 136 p refs
(Contract NAS9-8166)
(NASA-CR-108363; TRW-11176-H460-R0-00) Avail: CFSTI CSCL 17G

Equations and logic to be programmed for an all digital simulation of the AAP orbital workshop (OWS) pointing control system (PCS) and thrust attitude control system (TACS) are presented. The program was developed in a modular form such that the final software could be incorporated without disturbing the overall program structure. In many undefined areas, subroutines have been developed which anticipate the software to be incorporated in the onboard computer (on the basis of the physical principles involved and any available documentation). Changes to the simulation will be made as the software to be programmed in the onboard computer becomes finalized. A block diagram of the OWS attitude control systems (ACS) is shown. The portions of the OWS ACS which are modelled in this simulation include the CMG subsystem, the thrust attitude control system (TACS) jets, the pointing control system (PCS) and TACS software in the ATM digital computer, the star tracker, the vehicle rate gyros, and the acquisition sun sensors. Author

N70-24289*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATTITUDE REACQUISITION OF A GRAVITY-GRADIENT CONTROL-MOMENT-GYRO STABILIZED SPACECRAFT

Clark E. Stohl and Bruce E. LeRoy Washington Apr. 1970 30 p refs
(NASA-TN-D-5772; E-5493) Avail: CFSTI CSCL 17G

Impulsive or time-decaying disturbances of sufficient magnitude will cause a gravity-graident control-moment-gyro stabilized spacecraft to tumble. A procedure for operating a thruster system by ground command to perform reacquisition was functionally designed and evaluated on an analog computer. When the disturbance has ceased, an on-board thruster system is used to aline the total angular momentum vector of the spacecraft in an orientation that allows the control-moment gyros to damp all spacecraft motion into a single axis. This single-axis rate can then be directly despun. For a spacecraft in a Sun-synchronous orbit, a procedure was found to shorten the time for attitude reacquisition by using a solar array for crude attitude information. Author

N70-24304*# AC Electronics-Defense Research Labs., Santa Barbara, Calif.
APOLLO PRIMARY GUIDANCE NAVIGATION AND CONTROL SYSTEM (PGNCS) Final Report
2 Mar. 1970 510 p
(Contract NAS9-497)
(NASA-CR-108362; EP0021) Avail: CFSTI CSCL 17G

A summary of program accomplishments in the design and development of the Apollo Primary Guidance Navigation and Control System is presented in a tabular format. Aspects of the program dealt with include: (1) work objectives and work category descriptions, (2) engineering and management, (3) documentation, (4) reliability and quality assurance, and (5) hardware. D.L.G.

N70-24308*# TRW Systems, Redondo Beach, Calif. Guidance Analysis and Software Dept.
PROJECT TECHNICAL REPORT TASK MSC/TRW KM-205, CSM IMU COARSE ALIGNMENT TO ATM SENSORS FOR AAP
J. B. Hill 26 Feb. 1970 47 p refs
(Contract NAS9-8166)
(NASA-CR-108320; TRW-11176-H485-R0-00) Avail: CFSTI CSCL 17G

The capability was determined of performing an IMU coarse alignment non-optically while the CSM/SWS cluster is holding solar inertial attitude during an AAP mission. Two CSM IMU coarse alignment techniques were analyzed in detail. In one technique, the CSM attitude is determined by transforming ATM sensor data through successive structural interfaces. A nominal transformation is assumed at each interface. In the other technique, the transformation from sensor data to CSM IMU alignment is determined by comparing an initial IMU alignment with an ATM sensor measurement. Subsequent coarse alignments are made by applying this computed transformation. The accuracy of the second technique is generally sufficient to assure the use of auto optics positioning on a given star, thus permitting a fine optical IMU alignment. With the first coarse align technique, the star image can be expected to lie in the sextant field-of-view about 90 percent of the time. Author

N70-24309*# Rensselaer Polytechnic Inst., Troy, N.Y. School of Engineering.
ANALYSIS AND DESIGN OF A CAPSULE LANDING SYSTEM AND SURFACE VEHICLE CONTROL SYSTEM FOR MARS EXPLORATION Technical Progress Report, 1 Jul. - 31 Dec. 1969
D. K. Frederick, P. K. Lashmet, G. N. Sandor, C. N. Shen, E. J. Smith et al 1 Mar. 1970 55 p refs
(Grant NGL-33-018-091)
(NASA-CR-109395; RPI-TR-MP-12) Avail: CFSTI CSCL 17G

An investigation of problems related to the landing and controlling of a mobile planetary vehicle according to a systematic plan of exploration of Mars was undertaken. Problem areas receiving consideration include: updating of atmospheric parameters during entry, adaptive trajectory control, unpowered aerodynamic landing, terrain modeling and obstacle sensing, vehicle design, dynamics and attitude control, and chromatographic system design concepts. The specific tasks undertaken are defined and the progress made is summarized. Author

N70-24442 Pennsylvania Univ., Philadelphia.
POSITION CONTROL OF HELICOPTERS IN FORMATION FLIGHT
Arthur E. Franke (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-21350

A study and solution of the problems associated with the synthesis of an automatic station-keeping system for helicopters in formation flight is presented. A station-keeping system, which is dynamically compatible with the UH-1 helicopter and the AN/ASW-12 autopilot, is designed and a procedure is outlined which can be applied in designing a stationkeeping system to operate with any aircraft and autopilot. This design procedure utilizes a combination of control analysis techniques and digital simulation. A complex multivariable position control system is required to perform the stationkeeping task. A digital computer program has been prepared to simulate this system so its performance can be experimentally evaluated. Dissert. Abstr.

N70-24503# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AUTOMATIC ORBIT CONTROL OF THE LINCOLN EXPERIMENTAL SATELLITE, LES-6 Technical Report
Alvise A. Braga-Illa 10 Jul. 1969 63 p refs
(Contract AF 19(628)-5167)
(AD-697955; TR-469; ESD-TR-69-203) Avail: CFSTI CSCL 22/2

The report discusses the autonomous orbit control system launched aboard the synchronous communications satellite LES-6 in late 1968. The topics presented include the motivation for automatic orbit control, the measurement techniques, observability and controllability, the design of a variable limit-cycle system, automatic station acquisition, simulation, and testing. The history of the development of this control system is emphasized, and the early flight results are discussed. Author (TAB)

N70-24743# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF AREA NAVIGATION IN THE NORTHEAST CORRIDOR Final Report
Bernhart V. Dinerman Jan. 1970 112 p
(AD-699183; NA-70-3; FAA-RD-69-53) Avail: CFSTI CSCL 17/7

Aircraft space position data were collected during flights over area navigation routes and conventional victor airways. The prime measurement source was the New York Air Route Traffic Control Center surveillance radar and secondary beacon radar with a beacon video digitizer output to a specially developed magnetic tape recorder. The final format of the measurement data analysis consisted of statistical computations of the lateral deviations of the aircraft from the desired course. Measurements were made during a total of 223 flights on four area navigation routes and a total of 117 flights on four conventional routes. The measurements of the conventional navigation flights on the preferred victor airways were made for comparison purposes. Author (TAB)

N70-24869 Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCED NAVIGATIONAL TECHNIQUES
W. T. Blackband (RAE, Farnborough) Slough, England Technivision Services Jan. 1970 354 p refs Proc. of the 14th Symp. of the Avionics Panel, Milan, 12-15 Sep. 1967
(AGARD-CP-28) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

Conference papers pertain to the future requirements for navigation for aircraft, and for hydrographic and oceanographic vessels; general ground-based navigational aids, with particular reference to Omega; Doppler-VOR modifications; and satellites for air and marine navigation and traffic control. For individual titles, see N70-24860 through N70-24885.

N70-24860 Coast and Geodetic Survey, Rockville, Md.
NAVIGATION NEEDS AND PROBLEMS OF HYDROGRAPHIC AND OCEANOGRAPHIC VESSELS
T. J. Hickley *In* AGARD Advanced Navigational Tech. Jan. 1970 p 3–9 ref (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Routine measurements performed by hydrographic and oceanographic vessels are cataloged and classified, and the positioning and tracking requirements to bring meaning to these measurements are defined. Time dependent variables include water temperature; wave height, length, and period; current; and distribution of salinity, dissolved gases, dissolved organic material, plankton, and fish. Emphasis is placed on the time independent variables: geomagnetic field close to the water surface; gravity measurements; bathymetric surveys for constructing navigation charts and other uses; and subbottom profiling. Navigation system requirements not satisfied by present day systems for exact positioning far at sea and near shore are listed. N.E.N.

N70-24861 Pan American World Airways, Inc., New York.
AN INTERNATIONAL AIRLINE VIEWS NAVIGATION SATELLITES
B. F. Mc Leod *In* AGARD Advanced Navigation Tech. Jan. 1970 p 11–15 (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Airline and ATC requirements and and plans for meeting requirements are discussed. It is felt that a reduction in separation is the only answer to the increased traffic, satellite navigation is welcomed as a supplementary aid, and a high quality, long range communications system is the most immediate pressing need. Plans for implementing a VHF communications system are outlined, and airlines' experiance with navigation satellites is mentioned. N.E.N.

N70-24862 Air Transport Association of America, Washington, D.C.
A VIEW OF AIRLINE REQUIREMENTS FOR AIDS TO LONG-DISTANCE NAVIGATION
Siegbert B. Poritzky *In* AGARD Advanced Navigational Tech. Jan. 1970 p 17-22 (See N70-24859 11-21) ref
Copyright. Avail: Technivision, Barywick House, Maidenhead, Berks, Engl. US Distribuor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The conditions under which a ground-based or satellite-based navigation aid might become necessary as a complement to or substitute for self-contained navigation systems are discussed. The accuracy of inertial systems is described and is considered to be adequate for a 90 and a 60 mile separation. It is further felt that reliability can be achieved with a dual inertial system. The problem of failure detection is reviewed and methods of solving it are outlined. Blunders in position errors not having normal or predictable distributions and back-up systems are discussed. N.E.N.

N70-24863 Deutsches Hydrographisches Institut, Hamburg (West Germany).
THE FUTURE DEVELOPMENT OF LONG RANGE NAVIGATION AT SEA
H. C. Freiesleben *In* AGARD Advanced Navigational Tech. Jan. 1970 p 23–30 refs (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The past and present of long range navigation aids are reviewed. Requirements influencing development are the demand for greater accuracy of position fixing, continuous and worldwide availability, and greater safety. The requirements arise mostly from military and scientific interests, but it is also necessary to regard the views of the practical navigator. In additon to radio systems, Omega in particular, navigation by satellites has the best chance for the future. Naval and research ships will be satisfied by the passive Navy Satellite System whilst in merchant shipping an active system will be preferred, offering communication possibilities. Further automation by inertial navigation systems and electronic computers will win interest, for accuracy on naval and research vessels, and for economic reasons on merchant ships. Author

N70-24864 Boeing Co., Seattle, Wash.
THE SUPERSONIC TRANSPORT NAVIGATION SYSTEM
A. F. Norwood and D. Manis *In* AGARD Advanced Navigational Tech. Jan. 1970 p 31–46 (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A brief rationale for the design of the primary long range navigation system for the U.S. supersonic transport is presented. The growth of commercial air transportation and the air traffic control environment are examined, and the penalties of inaccurate navigation and the limitations of conventional attitude and heading sensors are discussed. Operational goals are summarized, and Doppler radar systems, navigation aids, inertial systems, and certain combinations of system components are investigated to determine the capability of each candidate system to meet the required goals. Analyses of study results favor the use of inertial navigation systems. A comparison of various inertial system configurations leads to the selection of a design that best satisfies goals of performance, reliability, rapid aircraft turn-around, and dispatch capability. Author

N70-24865* Navy Omega Navigation System Project Office, Falls Church, Va.
THE OMEGA SYSTEM OF NAVIGATION
C. C. Stout *In* AGARD Advanced Navigational Tech. Jan. 1970 p 47–62 refs (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The Omega Navigation System and its uses are described. Research and development of the system is almost complete. Military receivers were designed and proven in thousands of hours of service. Transmitting station electronics equipment was fully tested and proven in an operational evaluation which has been underway since early 1966. Station operating procedures were also thoroughly evaluated. Design studies were completed for construction of antennas, buildings, and other facilities. Charts, skywave correction tables, and other software were prepared and tested in service by both military and civilian users. Author

N70-24866* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE RELAY OF OMEGA NAVIGATION SIGNALS BY SATELLITE TO A CENTRAL PROCESSING FACILITY
C. R. Laughlin *In* AGARD Advanced Navigational Tech. Jan. 1970 p 63–76 refs (See N70-24859 11-21)
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An experimental system known as the Omega Position Location Equipment (OPLE) is being developed. The OPLE experiment will commence with the launching of the Applications Technology

Satellite scheduled for mid-November of 1967. The purpose of the OPLE experiment is to demonstrate the operational feasibility of a centralized global meteorological data collection system utilizing the Omega navigation network in conjunction with geosynchronous satellite-borne repeaters. A significant feature of the OPLE is that Omega signals, as received at remote locations, are relayed through the satellite to a central processing center; the positions of the remote receivers are then automatically determined by a computer facility. The remote equipments function essentially as VLF to VHF transponders and the simplicity of their operation makes them compatible with a variety of mobile platforms. While the OPLE experiment is specifically designed for application with a balloon-borne meteorological data collection system, other potential applications include oceanographic exploration, marine and air traffic control, and reentered space vehicle recovery. Author

N70-24867 Decca Navigator Co., Ltd., Londong (England).
ON THE SIGNAL FORMAT FOR THE OMEGA SYSTEM
C. Powell *In* AGARD Advanced Navigational Tech. Jan. 1970 p 77 - 85 ref (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Reference is made to two aspects of the signal format proposed for an eight-station Omega network: the organization of the successive bursts of signal in a manner facilitating their acquisition by the users' receivers, and the composition of the so-called side frequency signals to be radiated in the periods between the time-shared signals. An equi-period format is suggested, in the use of which the amplitude of the signal from the nearest station is the primary recognition factor, confirmatory data being given by additional transmissions of the basic frequencies in a modified sequence; and preference is expressed for a harmonically-related rather than a submultiple spectrum for the side-frequencies. These topics lead to consideration of a simple integrating receiver, and of a concept, applicable to more elaborate equipment, which combines the time multiplex and frequency multiplex signals in a manner that would substantially increase the efficiency, in terms of the duty cycle, of the overall system. Author

N70-24868 Royal Aircraft Establishment, Farnborough (England).
THE EXTENSION OF THE LONG RANGE AIRCRAFT NAVIGATION SYSTEM TO THE SHORT RANGE ROLE
F. S. Stringer *In* AGARD Advanced Navigational Tech. Jan. 1970 p 87 - 90 (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The hybrid system comprises one self-contained integrating sensor such as an inertia navigator and one fixing system such as Omega with good long term stability and a high degree of integrity. The differential Omega technique is considered as a means of updating the inertia component, monitoring it during the descent or climb-out, providing a station keeping facility, and providing a self-sufficient secondary system in the event of a complete failure of the dead reconing aids. It is concluded that the extension of a hybrid long range en route navigation system, if it includes Omega, has the development potential to provide a world-wide rational system of navigation, capable of meeting the ATC and terrain problems presented over the en route/terminal area interface universally, and of providing other advantages such as stationkeeping. Author

N70-24869 AEG-Telefunken, Ulm (West Germany).
TELEVOR: A NEW PRINCIPLE FOR PRODUCING RADIAL RADIO COORDINATES IN THE LOW AND HIGH FREQUENCY BANDS
A. Prichodjko and A. Simianer *In* AGARD Advanced Navigational Tech. Jan. 1970 p 91 - 104 (See N70-24859 11-21)
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The problems of producing radial radio coordinates at low radio frequencies are considered. It is shown that a ring antenna system can be fed so as to meet the requirements of a navigational system. The radiated field is very little affected by propagation conditions and as a result bearing errors at long range are likely to be small. Author

N70-24870 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
UTILIZATION OF HIGH STABILITY CLOCKS FOR TRAJECTOGRAPHY [UTILISATION POUR LA TRAJECTORGRAPHIE D'HORLOGES A HAUTE STABILITE]
R. Moreau *In* AGARD Advanced Navigational Tech. Jan. 1970 p 105 - 115 refs In FRENCH; ENGLISH summary (See N70-24859 11-21)
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High stability clocks, and particularly atomic clocks, open the way to applying new trajectography principles. Basic research in this field provided the charecteristics of the clocks to be used and with the experimental single-channel equipment leading to the location of a vehicle in space. This equipment is described. The results obtained with the system using rubidium vapor clocks are shown and the future of such equipment is discussed. Author

N70-24871 Ministry of Technology, London (England). Electronics Research and Development Branch.
OCEAN PLATFORMS FOR CIVIL AVIATION OPERATIONS OVER THE NORTH ATALNTIC
L. J. Braybrook *In* AGARD Advanced Navigation Tech. Jan. 1970 p 117 - 128 refs (See N70-24859 11-21)
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The chapter describes the concept of stable moored ocean platforms to provide a reliable VHF communications service and secondary surveillance radar facilities to civil aircraft on the main air routes across the North Atlantic. The communications and data links between the ocean platforms and the air traffic control centers would be provided either by submarine telephone cables or by the use of a sea station to satellite to ground relay as part of a commercial point-to-point communications service. The satellite might also provide one or two channels on either VHF or L band which would enable suitably equipped aircraft to communicate directly through the satellite. The ocean platforms would provide both communications and surveillance capability without new types of aircraft equipment on VHF and UHF and would be available for operational use once the link from sea station to ATC center has been established. The main features of the platform and the communications links by cable and satellite are discussed and some idea of the time scale and costs is given. Author

N70-24872* Standard Electrik Lorenz A. G., Stuttgart (West Germany).
THE DOPPLER VOR: ITS FOUNDATION AND RESULTS
E. L. Kramar *In* AGARD Advanced Navigational Tech. Jan. 1970 p 129 - 142 refs (See N70-24859 11-21)
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Because of very good experience with wide base direction finders the development of the Doppler VOR was initiated a few years ago. Considerably improving the accuracy of course indication even during flights over very unfavorable terrain and essentially reducing siting requirements, the system has come up to expectations in practical operation. The new concept represents a significant

advance in the field of radio navigation aids, solving problems the conventional systems do not perform satisfactorily. Offering increased course accuracy the D-VOR will allow very precise area coverage in conjunction with a DME ground station. By providing an offset computer in addtion to the existing airborne equipment, automatic guidance of aircraft on any desired course will be possible within the range of such combined D-VOR-DME installations. Author

N70-24875 Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE UNITED STATES NAVY NAVIGATION SATELLITE SYSTEM
R. B. Kershner *In* AGARD Advanced Navigational Tech. Jan. 1970 p 185 - 194 (See N70-24859 11-21)
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The recent development of the program and the present status are described. Some of the problems encountered in the development of the satellite design are mentioned and the solution adopted is described. In particular the connection between system accuracy and geodesy is stressed and the level of accuracy now achieved is given. Finally some of the prospective future advances are mentioned. Author

N70-24876 Siemens A.G., Munich (West Germany). Central Communications Lab.
AN AERONAUTICAL SATELLITE SYSTEM COVERING THE NORTH ATLANTIC AREA
Hans G. Leysieffer *In* AGARD Advanced Navigational Tech. Jan. 1970 p 195 204 refs (See N70-24859 11-21)
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To increase the reliability of air traffic monitoring methods, two independent radio location systems are proposed which allow the simultaneous position display of up to 300 aircraft and the silent control of the entire air situation. The first method is based on a simple communications system where, in 300 parallel-working narrow channels, the position data determined by airborne equipment in the aircraft are automatically transmitted to a ground station via a satellite. The second method determines the positions in succession from the ground by the propagation time difference of signals which, via two differently-positioned synchronous satellites, travel to the aircraft and, via transponders, back to the ground. The second system furthermore provides twenty voice channels for air to ground traffic via satellites. By the methods of secondary radar engineering these channels are exchanged by correspondingly selected pulse telegrams which, if required, are added to the radio location pulses on the ground and in the aircraft, respectively. Author

N70-24877 Radio Corp. of America, Moorestown, N.J.
THE SPOT NAVIGATION SATELLITE SYSTEM
J. Breckman and J. D. Barnla *In* AGARD Advanced Navigational Tech. Jan. 1970 p 205 219 (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Based on the studies completed to date, SPOT is a global, all-weather, always-available navigation system which gives near-instantaneous fixes or continuous tracks where desired. It can provide height, velocity and automatic guidance and control signals as well as position. All of the art needed to implement SPOT exists today. The prospective fields of application for SPOT include: nonsaturable air traffic control simultaneous with passive user operation; in-flight and terminal navigation; air and sea search and rescue; continuous flight logging; automatic guidance; near-earth satellite rendezvous and mid-course correction; ballistic missile insertion and reentry; surface hazard markers; aerial survey, oceanographic and meteorological control; jam-resistant strategic and tactical military operations; maritime navigation; harbor control; and the navigation and control of land vehicles. Author

N70-24878# Westinghouse Electric Corp., Baltimore, Md.
PRELIMINARY INVESTIGATION OF NAVIGATION SATELLITE TECHNIQUES FOR ACHIEVEING ACCURACIES IN POSITION OF THE ORDER OF TEN METRES
E. S. Keats *In* AGARD Advanced Navigational Tech. Jan. 1970 p 221 - 229 (See N70-24851 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A navigation satellite system with 10-meter accuracy, continuous coverage, rapid position determination, simultaneous service, and immunity to interference may be achieved by satellites in 24-hour orbits employing passive interferometric or hyperbolic techniques. They achieve a high sensitivity when their antennas are widely separated. Direction is determined by measuring radio signals broadcast from three antennas and angle ambiguity is resolved by using several frequencies. Errors due to the earth's atmosphere are largely eliminated because the angles are established at the satellites. The antennas are separated by placing them on different satellites. A family of satellites might be connected by light wires and orbit as a group. Alternatively, the satellites could be placed in orbits of related inclination and ellipticity so that gravitational forces constrain them to remain together. Such a system could provide polar coverage. Author

N70-24879* General Electric Co., Schenectady, N.Y.
INDEPENDENT SURVEILLANCE AND COMMUNICATION USING SATELLITES
R. E. Anderson *In* AGARD Advanced Navigational Tech. Jan. 1970 p 231 256 (See N70-24859 11-21)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A postulated system uses satellites and cooperating ground stations to provide independent surveillance of the positions of aircraft and ships, and also undelayed voice and digital communication. The system employs a low energy speech transmission technique (LEST) that requires only a fraction of the energy needed for FM or conventional AM transmissions, so that a small satellite can provide an operationally useful number of channels with good performance margins. Intelligibility is approximately 95 per cent on spondaic words, although the quality is rather harsh. Position fixes are made by pulse train ranging from pairs of satellites. Accuracy is adequate for air traffic control at VHF frequencies. One nautical mile accuracy can be provided at higher frequencies. Transmissions are interfeaved between present VHF channel assignments. Communications and automatic position fixing are provided by a small unit that can be added to existing VHF receivers and transmitters so that it is easy to retrofit existing craft. LEST and pulse train ranging use the same pulse format. All transmission, including voice, can be used in the range measurements, thus minimizing the need for special synchronizing signals. User multiple addressing is simple. Author

N70-24880* Michigan Univ., Ann Arbor. Inst. of Science and Technology.
HYPERBOLIC POSITION FINDING WITH SYNCHRONOUS SATELLITES
G. W. Casserly and E. D. Mc Conkey *In* AGARD Advanced Navigational Tech. Jan. 1970 p 257 260 (See N70-24821 11-21)
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The characteristics are presented of several hyperbolic

configurations in which one or more of the stations are located on stationary satellites. Particular attention is paid to the characteristics of the line of position patterns on the surface of the earth and to the root mean square distance error in position finding. Station location errors, measurement errors, and propagation effects are considered in the calculation of the position errors. Several sources of major difficulty are identified of which satellite movement is the most serious. Methods of overcoming the difficulties are suggested. Author

N70-24881* Michigan Univ., Ann Arbor. Inst. of Science and Technology.

A UNIFIED APPROACH TO THE ERROR ANALYSIS OF POSITION FINDING TECHNIQUES

G. W. Casserly and E. D. Mc Conkey *In* AGARD Advanced Navigational Tech. Jan. 1970 p 261–269 refs (See N70-24859 11-21)

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It is shown that a large class of position finding configurations can be error analyzed through the use of a single analytical model. The model is composed of the equations that describe the differential relationships between the error sources and the resulting position error. The generality of application is achieved by writing the equations of the model in terms of gradients of the measurement functions. The analytical model is derived in terms of vectors and matrices. A specific example is then presented to illustrate the method. Finally, equations are presented to indicate how a variety of individual measurement functions can be entered into the general model. Author

N70-24882 RAND Corp., Santa Monica, Calif.

ERROR SENSITIVITY ASSOCIATED WITH ORBITAL HYPERBOLIC-NAVIGATION SCHEMES AND A SUGGESTED APPROACH FOR IMPROVEMENT

J. H. Hutcheson *In* AGARD Advanced Navigational Tech. Jan. 1970 p 271–290 refs (See N70-24859 11-21)

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The fundamental mathematical relationships applicable to satellite-linked hyperbolic systems in general are discussed. Error expressions are developed for determining the sensitivity of a system to uncertainties in measurement and to satellite geometry. A loran satellite system involves obtaining lines of position from the intersection of hyperboloids of revolution with spherical earth. The resultant second-order equations are solved by a computer using iterative techniques. Solutions in the form of error sensitivities are presented for a number of vehicle-satellite geometric configurations. Results are presented from the standpoint of navigators' lines of position (LOP's) intersecting at unfavorable angles that can cause the sensitivity to error to become unbounded. The problem becomes more complicated if satellite relative motion is involved because the orientation of the LOP's will change as a function of time. However, results indicate that certain general statements can be made regarding the number of satellites needed and the configurations necessary to meet a specified set of operational requirements. Author

N70-24883 Cubic Corp., San Diego, Calif.

GEODETIC SECOR

J. E. Howell *In* AGARD Advanced Navigational Tech. Jan. 1970 p 291–304 refs (See N70-24859 11-21)

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The SECOR system employs electronic phase comparison to accurately determine the distance from four stations on the ground to a small orbiting satellite. Extensive tests have consistently shown accuracy of satellite position determination of better than 3 meters. The accuracy of a satellite navigation system is dependent upon the location accuracy of the satellite tracking sites. SECOR is improving the accuracy of this site location. Author

N70-24884 Geonautics, Inc., Washington, D.C.

NASA GEODETIC SATELLITE PROGRAM CONTRIBUTIONS TO LONG-RANGE NAVIGATION

R. D. Brown and R. L. Taylor *In* AGARD Advanced Navigational Tech. Jan. 1970 p 305–318 refs (See N70-24859 11-21)

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The scope and objectives of the program are presented, as is a description of the satellites and tracking systems used in the program. A primary contribution of the program to long-range navigation can be more accurate positioning of new and existing navigation aid and tracking stations, such as Loran or STADAN stations, relative to one another and relative to the earth's center of mass. Available results from the GEOS-1 and Pageos satellites are discussed. These results include data from the optical, Doppler, range and range rate, and laser systems and intercomparison of the various systems. Author

N70-24885 Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).

THE FRENCH GEODETIC SATELLITES DIADEME 1 AND 2: CONTRIBUTION TO THE EXPERIMENT WITH SATELLITE NAVIGATION

J. C. Husson and A. Banchereau *In* AGARD Advanced Navigation Tech. Jan. 1970 p 319–337 refs In FRENCH (See N70-24859 11-21)

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Preliminary experiments using Diademe geodetic satellites for effective localization operations are presented. Localization operations were performed by the Doppler method and laser telemetry. These satellites were used for sounding operations in the ocean. Transl. by J.M.C.

N70-24898# California Univ., Livermore. Lawrence Radiation Lab.

WISPIN COMPUTER PROGRAM FOR SIMULATION OF WISP INERTIAL NAVIGATOR

Robert Henderson 23 Apr. 1969 91 p refs

(Contract W-7405-eng-48)

(UCRL-50650) Avail: CFSTI

A method is presented to directly simulate the operation of an inertial navigation system. Errors in velocity, position and gyro torquing signals are determined for a particular set of input data rather than statistical estimates of the errors. The advantages of this method are a more direct simulation of the reference platform control signals and greater flexibility in gyro drift and vehicle motion input. The basic navigation equations for velocity, position and gyro torquing signals are given. Their modification for platform control and the numerical solution by the simulation program are described in detail. Author (NSA)

N70-24932# Entwicklungsring Nord, Bremen (West Germany).

RESULTS OF THE DEVELOPMENT OF THE YO-YO SYSTEM FOR THE AZUR SATELLITE [ERGEBNISSE DER ENTWICKLUNG DES YO-YO SYSTEMS FUER DEN SATELLITEN AZUR]

A. Tegtmeier Sep. 1969 22 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969

Avail: CFSTI

The AZUR satellite will be launched into orbit with a 4-stage Scout rocket and after separation of the last stage the satellite will rotate at about 180 revs/min. The satellite will be despun by a yo-yo device and this paper describes theitheory of the device and discusses the ground tests and error analysis. ESRO

N70-24933# Contraves Corp., Zurich (Switzerland).
RESULTS OF THE ATTITUDE STABILISATION OF THE ESRO-1 SATELLITE (AURORAE) [ERGEBNISSE DER LAGESTABILISIERUNG DES SATELLITEN ESRO-1 (AURORAE)]
F. Haenni 1969 20 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The attitude stabilization systems of the ESRO-1 satellite consists of the yo-yo system on the equatorial ring, two permanent magnets parallel to the reference axis and 20 damping rods of soft magnetic material, arranged in groups perpendicular to the reference axis. The stabilization procedures using the above elements are described for the launching, transition and stabilized phases. It has been found that in the final phase there is an increasing angle deviation due to periodical geomagnetic disturbances and solar activity. ESRO

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-23905# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group
SNAP-21 PROGRAM, PHASE 2: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM Quarterly Report, 1 Jul.–30 Sep. 1969
30 Sep. 1969 119 p refs
(Contract AT(30-1)-3691)
(MMM-3691-57; QR-13) Avail: CFSTI

The final safety analysis report is included. The hydrostatic testing of System S10P4 was completed, along with the thermal and electrical characterization. The long-term testing of S10P4 was begun. System S10P3 was implanted off San Clemente Island. Phase I and II thermoelectric generators will continue to be tested. The conceptual design of the 20-watt system was completed and the selected configuration is a strontium oxide-fueled single generator that is basically a scaled-up 10-watt system. A drawing of the selected system is given. NSA

N70-23906# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
SODIUM TECHNOLOGY DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS Quarterly Progress Report, Jun.–Aug. 1969
Sep. 1969 36 p refs
(Contract AT(04-3)-189)
(GEAP-13539; QPR-10) Avail: CFSTI

Chemistry control experiments were completed during operation of Loops 8 and 9 during the quarter. On-line instrumentation, sampling, and impurity monitors were operated to correlate impurity concentrations with cold trap and plugging temperatures. Cold trap temperatures were varied in the range 300 to 550 F and corresponding response noted for the oxygen meter, distillation sampler, and a hydrogen diffusion cell. The plugging meter was also used to monitor the effects of injection of a small quantity of water in the cover gas with the loop isothermal at 600 F. The characteristics of deposits in the cold leg of a sodium loop are the basis for the conclusion that particulates are nucleated in the main stream and subsequently deposited on surfaces. Distinct pictures of surface deposits of crystallite particles, 2 to 5 microns in size, have been obtained by a scanning electron microscope technique. Author (NSA)

N70-23908# Oak Ridge National Lab., Tenn.
RADIOISOTOPE PROGRAM (8000) Progress Report, 1 Oct.–30 Nov. 1969
A. F. Rupp Dec. 1969 48 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2807) Avail: CFSTI

Developments are reported for: radioisotope production, including neutron products, cyclotron products, fission products, and radiation sources; radioisotope source safety testing; technology utilization; radioisotope applications, including basic technology and systems engineering applications; radiation processing applications; and radioisotope sales. Papers reviewed and published in the information center are listed. Developments are also given on the RIST program to determine volume of sediment transport. NSA

N70-23911# Los Alamos Scientific Lab., N.Mex.
NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT Program Status Report, Jul.–Sep. 1969
G. Robert Keepin, ed. 21 Nov. 1969 27 p refs
(Contract W-7405-eng-36)
(LA-4315) Avail: CFSTI

Methods for the nondestructive assay of fissionable materials include neutron self-indication, prompt fission neutron assay of fissionable materials, californium-252 source, and delayed neutron assay of inventory samples and fissionable scrap. Passive and auxiliary assay techniques are discussed. The parameters of the delayed neutron yield-vs-energy measurements and delayed neutron abundances and half-lives in 14.9-MeV fission are given. The neutron detector development and the mobile nondestructive assay laboratory are described. Accelerators, neutron sources, and facility development for the nuclear safeguards research and development are discussed. NSA

N70-23914# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
DEVELOPMENT OF TUBULAR UO2 FUEL ELEMENTS FOR POWER REACTORS
A. S. Ferrara and W. G. Holmes Jul. 1969 82 p refs
(Contract AT(07-2)-1)
(DP-997) Avail: CFSTI

A process was developed for fabricating tubular fuel elements with compacted cores of fused and crushed UO2 in Zircaloy sheaths. Irradiation of more than 135 tubes with compacted uranic cores at test conditions that ranged up to 17,000 MWd/MtU peak exposure and 68 watts/cm peak thermal rating indicated that such tubes should operate satisfactorily in a full scale heavy water moderated power reactor to peak exposures of at least 20,000 MWd/MtU and peak thermal ratings of 30 watts/cm. Less than 10% of the fission gas produced during irradiation was released in fuel tubes operating below about 25 watts/cm; onset of columnar grain growth in the UO2 core occurred at about 25 watts/cm and coincided with a sharp rise in the fractional release of fission gas. Release of nitrogen from impurities in fused UO2 was substantially reduced by outgassing the UO2 at high temperature in a vacuum or in hydrogen before irradiation. The outer sheath wrinkled in tubes with relatively low-density cores (82 to 87% of theoretical density) when operated at $\Delta T/kd$ theta of 40–45 watts/cm; tubes compacted to 90% of theoretical density did not wrinkle when irradiated at 50 watts/cm. Author (NSA)

N70-23926*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF FUEL LOADING REQUIREMENTS AND NEUTRON ENERGY SPECTRUM OF A FAST SPECTRUM, MOLYBDENUM-REFLECTED, CRITICAL ASSEMBLY
Wendell Mayo and Edward Lantz 4 Mar. 1970 21 p refs
(NASA-TM-X-52782) Avail: CFSTI CSCL 18I

A limited number of small, heavy-metal-reflected, fast reactor, critical experiments have been performed to check the accuracy of

neutronic calculations. From these calculations it has been found that the amount of calculational error is strongly dependent on the materials in the reactor and in the neutron reflector. Since for the materials of interest the available experiments supply only about one data point, it was decided to embark on a critical experiment program wherein only the materials that were being considered for an actual, small, fast-spectrum reactor would be included. The conceptural reactor for which these experiments are being performed is a lithium-cooled, uranium-235 nitride fueled reactor. The purpose of this report is to present a precritical analysis of the fuel loading requirements and neutron energy spectrum of the first of a series of critical experiments. Author

N70-23936# Atomic Power Development Associates, Inc., Detroit, Mich.
CRITERIA FOR DETECTION OF SMALL SODIUM-WATER REACTIONS IN LMFBR STEAM GENERATORS
John H. Coleman, John A. Ford, and P. S. Lindsey 23 Nov. 1969 104 p refs
(APDA-TM-52) Avail: CFSTI

The major purpose of the development of leak detection systems for sodium-heated steam generators is to minimize the damage and large economic losses which can result from leakage of water into sodium. Only small leaks are considered in the analysis since adequate detection methods for large leaks exist and are in use. The criterion proposed for leak detection systems for small leaks is that these systems be capable of reliable detection so that the steam generator may be shut down by removal of the water and steam from the unit before significant damage has occurred. Significant damage is defined as that amount of damage which, if not repaired, would appreciably decrease the service life of the steam generator. The major elements and input required for a leak detection analysis are defined and described in addition to an actual analysis of a reference secondary system for a 1000-MW(e) LMFBR plant. Author (NSA)

N70-23977# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
ZERO POWER TESTS ON PM TYPE 4, REACTOR CORE 1
E. G. Taylor and A. Vukmir Oct. 1969 129 p refs
(Contract AT(30-1)-4014)
(WARD-104) Avail: CFSTI

The purpose of the program was to experimentally confirm the analytical reactors physical design parameters for the PM Type 4 replacement cores. The reactors that are in service operate with the Type 2 cores which utilize fully enriched U in the form of stainless steel clad UO2 tubular dispersion fuel elements. The Type 4 core utilizes 9.58% enriched U in the form of UO2 pellets, clad in stainless steel. The facility, equipment, and the techniques of measurement and data analysis are described, and the results of the measurements are presented. Author (NSA)

N70-23980# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
IMPROVED FABRICATION TECHNIQUES FOR LI 6 FLUORIDE-TEFLON AND LEAD SHIELDS FOR GAMMA DOSIMETRY
R. D. Rivers, J. W. Williams, Ted Lee, C. A. Kienberger, and C. W. Weber 22 Dec. 1969 38 p refs
(Contract W-7405-eng-26)
(K-1779) Avail: CFSTI

The development of lithium-6 fluoride-Teflon (Li-6)F-Teflon and lead shield assemblies to provide inexpensive dosimeters for gamma radiation is reviewed. The newly developed techniques include molding, in one pressing, the complete (Li-6)F-Teflon shield with a center hole for silver-activated phosphor glass rod detectors; lead foil serves as the lead source for the shield assembly. A description of the equipment, as well as the automation portion of the pressing procedures, is also presented. Author (NSA)

N70-23992# Sandia Corp., Albuquerque, N.Mex.
AEROSPACE NUCLEAR SAFETY PROGRAM
R. G. Illing, comp. Oct. 1969 30 p
(SC-PR-69-672) Avail: CFSTI

Drop test results for the Pioneer radioisotope thermoelectric generator are reported along with first phase results of Transit solid propellant burn tests. Work on advanced fuel safety is reported on reentry ablation, aerothermal analysis, similarity analysis, and material properties. The feasibility of simulating Transit capsule reentry under abort conditions was studied. Factors involved in rocket mission abort were studied to establish a basis for an abort model. NSA

N70-24003# Argonne National Lab., Idaho Falls, Idaho.
EFFECTS OF SODIUM AND SODIUM REMOVAL ON THE MICROSTRUCTURE OF TYPE 304L STAINLESS STEEL TUBING
R. V. Strain Aug. 1969 18 p refs
(Contract W-31-109-eng-38)
(ANL/EBR-6) Avail: CFSTI

Type 304L stainless steel tubing is employed as the cladding and encapsulation material for the driver fuel and most experimental capsules in the Experimental Breeder Reactor II (EBR-II) EBR-II is a sodium-cooled fast-breeder reactor and therefore exposes the outside surfaces of the elements and capsules to flowing sodium at temperatures from 700 to 1100 F. The sodium clinging to these surfaces must be removed prior to exposing the subassembly to air for interim or postirradiation examination. The removal is carried out by converting the sodium to sodium oxide and sodium hydroxide with humidified argon and air. The oxidized sodium is removed from the surfaces by flowing water through the subassembly. Metallographic examination has been performed on a large number of samples to determine the effects of the reactor primary sodium and sodium-removal operation on the microstructure of cladding and encapsulation material. Author (NSA)

N70-24044# Oak Ridge National Lab., Tenn.
FISSION-PRODUCT MONITORING IN HIGH-TEMPERATURE GAS-COOLED REACTORS
C. D. Baumann 1969 40 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2791) Avail: CFSTI

An instrumentation system capable of identifying and measuring the accumulation of fission products in high temperature gas cooled reactor coolant loop circuits and loop components is under development. The applicability of ionization chambers, beta and gamma spectrometers, charged-wire precipitators, Cerenkov detectors, filters, diffusion tubes, thermal gradient tubes, deposition tubes, and impactors as plateout monitors is discussed. It is recommended that the deposition tube and gamma spectrometer systems be further developed as component plateout monitors and tested first in a high temperature gas loop and then in reactor service. Author (NSA)

N70-24046# Oak Ridge National Lab., Tenn.
HIGH FLUX ISOTOPE REACTOR Quarterly Report, Jul. - Sep. 1969
R. V. Mc Cord and B. L. Corbett 16 Dec. 1969 17 p
(Contract W-7405-eng-26)
(ORNL-TM-2808) Avail: CFSTI

Operations and maintenance requirements are described. Design changes are listed. Radiation monitoring measurements are presented. NSA

N70-24068# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1969
25 Nov. 1969 144 p refs
(Contract W-31-109-eng-38)
(ANL-7632) Avail: CFSTI

Highlights of project activities are summarized for the month of October 1969. LMFBR physics measurements and ZPR-3, ZPR-6, ZPR-9, and ZPPR operations during October are reviewed. Fuel and components development programs for the LMFBR are described. Research and development programs in the EBR-2 are reviewed. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. NSA

N70-24076# Nuclear Materials and Equipment Corp., Leechburg, Pa. Plutonium Lab.
DEVELOPMENT AND TESTING OF PU-O2-UO2 FAST REACTOR FUELS Quarterly Report, Jan. - Mar. 1969
Aug. 1969 32 p
(Contract AT(30-1)-3524)
(NUMEC-3524-67) Avail: CFSTI

Subassembly XO15 containing 11 NUMEC fuel capsules was removed from the ERB-II reactor after completing the scheduled irradiation exposure goal. Peak burnup of these 20% PuO2-UO2-316L clad rods is 57,000 MWd/te. Subassembly XO12 containing 19 C Series fuel capsules is continuing its irradiation toward a goal exposure of 100,000 MWd/te. Diametral changes in the A-Series fuel rods irradiated to 33,000 MWd/te peak at 12 to 15 kW/ft in EBR-II ranged from 0.50 to 0.82% delta D/D peak based on preliminary measurements prior to precision profilometry. The peak diametral increase for 6 rods containing 87 to 88% smeared density mixed oxide averaged 0.60% delta D/D. The peak diametral increase for 4 rods containing 80 to 82% smeared density fuel also averaged 0.60% delta D/D. Two rods containing 87.5% smeared density fuel fabricated with dished-end pellets averaged 0.68% delta D/D. The lowest diametral swelling observed in this test series occurred in an 87% smeared density fuel rod in 0.015 in. wall thickness Hastelloy-X. Author (NSA)

N70-24082# Minnesota Mining and Mfg. Co., St. Paul, Minn.
SNAP-23A PROGRAM, PHASE 1. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, 1 Jul. - 30 Sep. 1969
31 Oct. 1969 142 p
(Contract AT(30-1)-3824)
(MMM-3824-40; QR-11) Avail: CFSTI

Design analysis and development continued during fabrication and assembly of the SNAP-23A 60-watt converter PMC-2. Working drawings were issued and used for development work, manufacturing planning, and quality control planning. Converter performance was reevaluated at EOL design conditions. The completion of the fire safety design was finalized and submitted to the AEC. The design details of the six-couple test module were completed and piece-parts are being either processed or fabricated. Long term operation and testing continued on the 10-couple modules, and converters 23P2, EMC-2, EMC-3 and PMC-1B. NSA

N70-24106# Battelle-Northwest, Richland, Wash.
REMOVAL OF SUPERFICIAL BLEMISHES FROM TYPE 316 STAINLESS STEEL FUEL CLADDING
R. R. Studer Oct. 1969 18 p refs
(Contract AT(45-1)-1830)
(BNWL-1176) Avail: CFSTI

During visual examination of an end cap weld on a fuel pin subassembly made for PNL-6, discolorations were found, in about equal profusion, on all lots of Type 316 stainless steel fuel clad tubes produced by one manufacturer, but were absent on process scrap which had not been centerless ground on the outer surface. Tube bores were unaffected. Affected tubes retained normal mechanical properties. Cleaning procedures were revised so that blemishes could be removed without compromising the integrity of the fuel pins. Author (NSA)

N70-24107# NSA Research Corp., Evans City, Pa.
THE EFFECT OF HIGH TEMPERATURE SODIUM ON THE MECHANICAL PROPERTIES OF CANDIDATE ALLOYS FOR THE LMFBR PROGRAM Quarterly Progress Report, Apr. - Jun. 1969
L. H. Kirschler, R. H. Hiltz, and S. J. Rodgers Oct. 1969 86 p refs
(Contract AT(11-1)-765)
(MSAR-69-178) Avail: CFSTI

Creep-rupture testing of Type 304 and 316 ss samples was continued under Loop 3 operating conditions: low oxygen (less than 10 ppM) sodium, liquid flow velocity of 20 ft/sec across the test specimen, and a system delta T of greater than 70 deg. Creep-rupture testing of stainless-steel samples in 1200 deg air also was continued. Tests were completed for samples previously conditioned in the 1200 and 1400 F helium-high oxygen sodium excursions. In general, all the mechanical property data are being tabulated, correlated by appropriate mathematical relations, and subjected to computerized programs. Creep-rupture testing of Type 304 and 316 ss samples under the Loop 3 operating conditions described above under Task 1 completed the objectives of this task. Data correlations are in progress. Tensile tests in air and creep-rupture testing under Loop 3 conditions of 10,000-hour helium and clean sodium-exposed specimens are in progress. Author (NSA)

N70-24121# Mound Lab., Miamisburg, Ohio.
PU 238 ISOTOPIC FUEL FORM DATA SHEETS
W. H. Smith, D. R. Rogers, and C. L Silver 31 Oct. 1969 84 p refs Supersedes MLM-1564
(Contract AT(33-3)-GEN-53)
(MLM-1691) Avail: CFSTI

A compilation was made of data to September 1, 1969, on isotopic fuel forms of Pu-238. The data are presented under the following headings: metal, PuO2 microspheres, PuO2, PuC, PuN, and Pu-Zr alloy. NSA

N70-24128# Oak Ridge National Lab., Tenn.
FUEL MIGRATION IN PYROCARBON-COATED PARTICLES
M. T. Morgan, D. M. Hewette, E.L. Long, Jr., and O. Sisman Nov. 1969 94 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2717) Avail: CFSTI

Results are given on fuel migration and fuel-coating interaction as a result of irradiation and postirradiation anneals. Eight different batches of coated particles were studied, four containing UO2 and four containing UC2 as the fuel material. Irradiation-induced fuel-coating reaction was more extensive in the UC2-fueled particles. Post irradiation heat treatment caused no appreciable extension of damage areas in particles of either type fuel. Author (NSA)

N70-24135# Oak Ridge National Lab., Tenn.
FAILURE MODES OF ZIRCALOY-CLAD FUEL RODS. PART 3: DESCRIPTION OF THE ORNL PROGRAM
P. L. Rittenhouse Jan. 1970 42 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2474) Avail: CFSTI

Research and testing programs are being conducted at the Oak Ridge National Laboratory to determine the behavior of Zircaloy-clad fuel rods in the event of a loss-of-coolant accident in a light-water nuclear reactor and the effect of this behavior on the outcome of the accident. These studies will obtain information needed for the evaluation of the safety of large modern, boiling- and pressurized-water reactors. The program scope includes studies of the high-temperature mechanical properties of Zircaloy cladding and its embrittlement by steam as well as the effect of cladding failure mode on recovery from the temperature transient associated with the accident. The progress of these programs in fiscal year 1969 is described, and plans for fiscal years 1970 and 1971 are discussed. Author (NSA)

N70-24137# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
THE EFFECTS OF ENERGY SELF-SHIELDING IN REFLECTED AND MODERATED URANIUM METAL CRITICAL MASS CALCULATIONS
Douglas C. Hunt and Donald C. Coonfield 29 Sep. 1969 16 p
(Contract AT(29-1)-1106)
(RFP-1327) Avail: CFSTI

The effects of energy shielding (i.e., flux depeltion in high absorption energy regions) are studied on multigroup cross sections for enriched uranium metal systems by using several energy-shielding models. The neutron cross sections obtained are used in transport theory critical dimension calculations done with the Computer Code DTF-2. A 3 percent variation in slab thickness and 0.4 percent variation in sphere radius occur as the energy-shielding model is changed. Doppler temperature coefficients are found to be negative or zero in all cases with a maximum magnitude.
Author (NSA)

N70-24215# Gulf General Atomic, San Diego, Calif.
FISSION PRODUCT RELEASE MEASUREMENTS ON TRISO FUEL PARTICLES IRRADIATED IN CAPSULE P-13-F
C. C. Adams, S. Langer, W. E. Bell, R. D. Burnette, J. N. Graves et al 22 Oct. 1969 55 p refs
(Contract AT(04-3)-633)
(GA-9383) Avail: CFSTI

A review of metallic fission product release data for TRISO particles irradiated in the P-13F capsule indicates that these samples withstood fuel burnup of up to 13% FIMA with very little degradation of the SiC barrier coatings. The high incidence of initially defective particles in some of the samples probably accounted for the major amount of metallic fission product release observed for both the unirradiated and irradiated particles tested. The fuel contamination of the outer pyrolytic carbon (PyC) layers contributed to a lesser degree and the intrinsic release is probably even lower. Irradiated (11% FIMA) PyC- and SiC-coated particles can withstand high temperatures (up to 2300 C for several hours) without coating failure.
Author (NSA)

N70-24227# Atomics International, Canoga Park, Calif.
CHARACTERISTICS OF AEROSOLS PRODUCED BY SODIUM FIRES. VOLUME 2: COMPARISONS OF EXPERIMENT WITH A GENERAL EQUATION FOR THE COAGULATION OF HETEROGENEOUS AEROSOLS
M. A. Greenfield (California Univ., Los Angeles), R. L. Koontz, and O. H. Hausknecht 31 Oct. 1969 35 p refs
(Contract AT(04-3)-701)
(AI-AEC-12878-Vol-2) Avail: CFSTI

A comparison between solutions of modified equation with experimental results is reported. Liquid sodium at 1000 deg was exposed to an environment containing 4 to 21% oxygen. Some fraction of the oxidized sodium was released as an aerosol in a test chamber. Measurements were made of the airborne mass concentration, mass deposition rates on the floor and walls, and the particle size distribution, each as a function of time. Solutions of the general equation have been obtained by use of a digital computer, and comparisons were made with experimental findings. The model presented should help in providing an analytical approach in the safety analysis which describes the behavior of aerosols assumed to be released during a major liquid-metal cooled fast-breeder reactor accident.
NSA

N70-24343# Atomics International, Canoga Park, Calif.
FISSION PRODUCT BEHAVIOR LOOP FACILITY DESCRIPTION
J. Guon 15 Jun. 1969 30 p refs
(Contract AT(04-3)-701)
(AI-AEC-12800) Avail: CFSTI

A small forced circulation loop for use in studying the behavior of fission products in Na is described. Information is included on loop design and construction, and on instrumentation and control.
NSA

N70-24348*# Aerojet-General Corp., Azusa, Calif. Power Systems Dept.
DEVELOPMENT OF SPEED CONTROL FOR THE SNAP-8 ELECTRICAL GENERATING SYSTEM
S. L. Bradley Nov. 1969 57 p refs
(Contract NAS5-417)
(NASA-CR-72670; AEROJET-3114) Avail: CFSTI CSCL 18N

The design, fabrication and testing of the speed control used on the SNAP-8 electrical generating system is disucssed. A total of more than 10,000 hours of operation with the electrical generating system has provided information which verified that the speed control was capable of regulating the speed of the system to within + or − 1%, with an output frequency of 400 + or − 4 Hz. Test results are presented along with an evaluation of the speed control performance relative to the SNAP-8 electrical generating system.
Author

N70-24365# Argonne National Lab., Ill.
OPERATING EXPERIENCE WITH THE EBR-II ROTATING-PLUG FREEZE SEALS
Larry P. Cooper, Bernard C. Cerutti, and Donald W. Cissel Dec. 1969 46 p refs
(Contract W-31-109-eng-38)
(ANL-7617) Avail: CFSTI

EBR-2 uses a fusible-alloy seal for positive containment of the primary-tank argon atmosphere and for allowing movement of the rotating plugs. This basic concept was successfully demonstrated. The operating difficulties with the rotating-plug freeze seals were one of the major problems with the initial EBR-2 fuel handling equipment. These difficulties were largely eliminated, through the knowledge and experience gained in correcting malfunctions of the freeze seals. A development program to further improve the operating performance of the seals is in progress. It is concluded that a fusible-alloy seal can be reliably used to contain an inert gas atmosphere while allowing rotational movement of rotating shields.
Author

N70-24501# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUCLEAR REACTOR SAFETY [LA SECURITE DES REACTEURS NUCLEAIRES]
Jacques Furet Jun. 1969 72 p refs In FRENCH
(CEA-CONF-1368) Avail: CFSTI

General considerations of the safety of reactors are outlined. Application of safety procedures to power reactors is discussed. The need for codes and standardizations in power reactor manufacturing and construction is assessed. The economics of safety and reactor safety are discussed. Methods for analysis of the safety of reactors are described. Safety systems and redundance effects are discussed. Details of the circuit (safety-redundance) algebra and logic are included.
NSA

N70-24517# Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering.
QUANTITATIVE DETERMINATION OF THE STRUCTURE-PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIAL Quarterly Progress Report, 15 Jun. – 15 Sep. 1969
F. N. Rhines, R. T. DeHoff, and L. L. Hench Oct. 1969 14 p ref
(Contract AT(38-1)-552)
(SRO-552-1) Avail: CFSTI

Quantitative relationships between microstructure and physical and mechanical properties of porous nickel and UO2 bodies are to be investigated. The nickel powder has been procured and

characterized; sintered samples showed the development of porosity internally contained within the nickel powder particles. Quantitative microscopic analyses were made, and the results compared with earlier observations for other equiaxed powders which do not exhibit this internally confined porosity. Treatments for eliminating this porosity are under study. The development of metallographic procedures for UO2 has also been undertaken, and is reported. Author (NSA)

N70-24594# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.

SIMULATION EXPERIMENTS FOR FEEDBACK AND RECONDENSATION PROCESSES IN Na 2 FUEL ELEMENTS [SIMULATIONSEXPERIMENTE ZUM RUECKSTROEM- UND REKONDENSATIONSVORGANG IM NA 2 - BRENNELEMENT]

P. Fette Jul. 1969 17 p refs In GERMAN
(NP-18060) Avail: CFSTI

Disturbances in the coolant supply in Na-cooled fast breeder reactors can result in overheating and vaporization of the coolant in the affected fuel elements. The hypothetical maximum force from a collision of two fluid columns in the center of a fuel element as the result of condensation of vaporized coolant is examined both experimentally and theoretically. The experimental apparatus and procedures used are described, and results of the simulations are presented. NSA

N70-24616# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.

HEAT TRANSFER IN FINNED ROD CLUSTERS WITH AXIAL FLOW

V. Krett Nov. 1969 11 p refs
(ZJE-57) Avail: CFSTI

An account is given of the experimental equipment, methods of measurement and evaluation of the coefficient of friction, and the heat transfer coefficient on bundles of finned rods. Taking the conceptional possibilities of the HWGCR fuel elements into account the following two types of finned rods were used: the first type with 3 higher fins without any spacers and the second type with 12 and 15 lower fins with spacers. The results of measurements are given in nondimensional criteria dependent on geometrical characteristics of the bundles. The experiments were carried out on air loops in the range Re = 0.4 × 10 to the 5th power and 2 × 10 to the 5th power. Author (NSA)

N70-24628# MSA Research Corp., Evans City, Pa.

EFFECT OF HIGH TEMPERATURE SODIUM ON THE MECHANICAL PROPERTIES OF CANDIDATE ALLOYS FOR THE LMFBR PROGRAM. MSAR EVALUATION OF CANDIDATE FERRITIC ALLOYS FOR LMFBR SERVICE

Topical Report, No. 14

R. H. Hiltz and L. H. Kirschler Jul. 1969 40 p refs
(Contract AT(11-1)-765)
(MSAR-69-139) Avail: CFSTI

It was found that titanium is an effective stabilizer for carbon in the ferritic steels. The Nb-Ta composition utilized by Thyssen tube works also appears to be effective in holding carbon. Vanadium is a borderline material. The titanium-stabilized 5 Cr-1/2 Mo material was selected for further testing. The Nb-Ta stabilized material has seen sufficient trouble-free exposures in European work at 1050 F consistent with practical operation that it should be considered. Sufficient work must be accomplished to assure that the abnormal behavior observed in this steel at 1200 F and 3000 plus hours does not occur at lower temperature at longer times, particularly under the time-operating parameters to be imposed in American fast breeder reactors. It appears that the standard 2-1/4 Cr-1 Mo alloy is approaching an equilibrium condition with respect to the austenitic materials in this particular system at a carbon content of 200 ppM. This value will be further defined shortly upon removal of the 10,000-hour exposed materials from MSAR systems. In one 1000 MWe design study, the current design for secondary systems is based upon using the 2-1/4 Cr-1 Mo alloy and allowing it to decarburize and upgrading the material thickness to account for the loss in strength caused by decarburization. If an economical containment is to be designed to a lower strength limit of a decarburized Cr-Mo, then a better approach to the problem could be utilizing a 2-1/4 Cr-1 Mo alloy with a low initial (200 ppM) carbon level. This would not detract from the over-all performance but would eliminate the upstream transport of carbon embrittling the austenitic structure. Author (NSA)

N70-24647# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

MAPS OF THERMAL NEUTRON FLUX IN THE REACTOR

Jacques Vacher Jun. 1969 23 p refs In FRENCH Presented at l'Ecole d'Ete d'Herceg Novi, Yugoslavia
(CEA-CONF-1320) Avail: CFSTI

Methods for measurement of neutron fluxes in reactors are outlined; brief discussions of foil activation techniques, use of semi-conductor detectors, and use of fission chambers are given. Flux mapping of the EDG-2 and Siloe reactors are described; results are shown graphically. Author (NSA)

N70-24702 Washington Univ., Seattle.

THE ROLE OF RADIATION HEAT TRANSFER IN A GAS-COOLED FAST REACTOR

James Alvin Stoddard 1969 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-20279

The importance of thermal radiation in the coolant and fuel of a conceptual design for a gas cooled fast breeder reactor is discussed. This problem was solved by a numerical procedure which was capable of analyzing both the steady-state heat transfer in the fuel and the entrance region heat transfer in the coolant. This numerical procedure consisted of the simultaneous solution of the energy conservation equation, the Fourier conduction equation, and the linear Boltzmann equation, and the treatment of turbulent convection by the eddy diffusivity method. The energy and conduction equations were solved by standard difference techniques, and the Boltzmann equation was solved by the discrete ordinates method of neutron transport theory. Dissert. Abstr.

N70-24724 Ohio State Univ., Columbus.

THE NUMERICAL SOLUTION OF THE SPACE-TIME REACTOR KINETICS EQUATIONS USING AN ALTERNATING DIRECTION EXPLICIT PROCEDURE

Shrinivas Shankar Iyer 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-22151

A method of numerical solution of the space-dependent reactor kinetics equations was investigated which is potentially superior to other methods currently being used in reactor analyses for multidimensional cores. The method is termed the Alternating Direction Explicit Procedure. The Alternating Direction Explicit Procedure is a nodal method for solving a set of difference equations obtained from the space-dependent reactor kinetics equations. The technique combines the best features of explicit and implicit methods. The implicitness of the technique helps in the choice of large time steps with explicitness providing the ease of computation. Dissert. Abstr.

N70-24799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ESTIMATION OF SPATIAL CAPTURE DISTRIBUTIONS IN RESONANCE ABSORBERS

Donald Bogart Washington Apr. 1970 21 p refs
(NASA-TN-D-5737; E-5188) Avail: CFSTI CSCL 18F

A method is presented for computing spatial distributions of neutron capture in thick layers of resonance absorbers immersed in

moderating media. It employs group effective resonance integrals to precalculate group effective resonance cross sections that are universal functions of distance into the absorptive layer. The method is illustrated for captures in uranium-238 for the energy region 0.5 eV to 100 keV. The method is applied to a spherical reactor-shield containing alternate layers of uranium and lithium hydride; large differences in spatial capture and therefore in gamma ray escape fractions are obtained compared to broad multigroup results. Application of the method to the epi-cadmium capture rates at various radii of uranium rods as measured by Hellstrand provided results that agreed with the experiments very well. Author

N70-24991# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
METALLURGICAL PROPERTIES OF COLD-WORKED ZIRCALOY-2 PRESSURE TUBES IRRADIATED FOR FIVE YEARS IN THE NPD REACTOR
W. J. Langford Jan. 1970 34 p refs
(AECL-3516) Avail: CFSTI; Atomic Energy of Can., Ltd., Chalk River: $1.00

Zircaloy-2 pressure tubes were irradiated to a maximum neutron dose of 1.2 × 10 to the 21st power n/sq cm (>1 MeV) at 10,500 psi hoop stress in the nuclear power demonstration reactor. Post-irradiation examination showed that mechanical strength increased and ductility decreased as a result of the reactor service. The tubes can sustain a 4 in. axial slit at operating stress without catastrophic propagation of the slit, ensuring that coolant leakage would precede catastrophic fracture. Maximum deuterium uptake was 9 ppm per annum. The rolled joints at the tube ends were sound, and showed no evidence of leakage or corrosion. All measured properties were consistent with requirements for a pressure tube life of 30 years. Author

N70-25040# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC) Quarterly Progress Report, 1 Jul. - 30 Sep. 1969
15 Nov. 1969 65 p
(Contract AT(29-2)-2338)
(AI-AEC-12895; QPR-9) Avail: CFSTI

The tantalum alloy isotopic fuel capsule, developed under the Large Radioisotope Heat Source Capsule (LRHSC) Program for providing a capsule capable of operation in space at a surface temperature of 2000 F for five years, was selected for use in the Transit Program. Therefore, the LRHSC Program was divided into two tasks - the high temperature capsule technology program and the development of the fuel Capsule for Transit TRG. In the former task, six T-111 capsule shells were fabricated of which 2 were assembled into impact capsules and a third used in an internally heated capsule assembly; a process specification for arc plasma spraying of Al2O3 on the T-111 shell was written; creep testing of the capsules continued; two capsules were impact tested and found to be leak tight; and the development and fabrication of Transit-sized vented capsules is proceeding. In the second task, the program plan for developing and testing the refractory and noble metal components for the TRANSIT capsule are given. NSA

N70-25046# Brown Boveri/Krupp Reaktorbau G.m.b.H., Mannheim (West Germany).
COSTANZA BBK: A ONE DIMENSIONAL DYNAMIC CODE FOR HIGH TEMPERATURE GAS COOLER REACTORS
K. Friedrich (EURATOM) L. Massimo, and E. Vincenti Brussels EURATOM 1970 68 p refs *Its* Association No. 003-63-1 RGAD
(EUR-4410.e) Avail: CFSTI

On the basis of the already existing COSTANZA code for liquid cooled reactors a program was developed for the one-dimensional dynamic calculations of the high temperature gas cooled reactors. Author

N70-25062# Centro Informazioni Studi Esperienze, Milan (Italy).
CRITICAL HEAT FLUX (CHF) PREDICTION IN COMPLEX GEOMETRIES (ANNULI AND CLUSTERS) FROM A CORRELATION DEVELOPED FOR CIRCULAR CONDUITS
G. P. Gaspari, A. Hassid, and G. Vanoli Jun. 1968 84 p refs Presented at the 14th Ann. Meeting of the Am. Nucl. Soc., Toronto, 9-13 Jun. 1968
(Contract EURATOM-008-65-1-NTRI)
(CISE-R-276; CONF-680601-58; Rept-71) Avail: CFSTI

A new criterion is presented which is being developed for critical heat flux prediction in complex geometries with steam - water mixtures in annular-dispersed flow-starting from a correlation derived for circular conduits. Such criterion considers, at least to a certain extent, this enthalpy unbalance. The new criterion is based on the following: both in annular and clusters geometries, at given pressure, flow-rate, and geometry, the critical power (w sub s,i) relevant to the surface is affected by crisis in correspondence with the boiling length, is essentially related only to the boiling length itself (L sub a); and in rod bundles a tendency seems to exist for heat-transfer crisis to occur on a given rod which is not necessarily the most powered one; this is the case, for example, of the results obtained with a closely packed 19-rod bundle. This is in contrast with the correlating procedures predicting crisis to occur on the most powered rods as well as with what could be inferred from a rough subchannel analysis. Author (NSA)

N70-25065# European Atomic Energy Community, Karlsruhe (West Germany). Joint Nuclear Research Center.
THE PREPARATION OF UO2-PuO2 POWDERS BY CO-PRECIPITATION AND THE MANUFACTURE OF HIGH-DENSITY PELLETS [PREPARATION DES POUDRES D'UO2-PuO2 PAR CO-PRECIPITATION ET FABRICATION DES PASTILLES A HAUTE DENSITE]
E. Zamodrani, J. de Rijk, G. Dhoop, and H. Schoenherr 1969 26 p refs In FRENCH
(EUR-4389-F) Avail: CFSTI

UO2/PuO2 pellets with a density of over 90% of theoretical in solid solution were obtained with plutonium concentrations of less than 45%. The influence of a) the precipitation conditions and temperature, b) the calcination and reduction temperatures and c) the compacting pressure on the final density of the sintered material was examined with the aim of applying this method to powders with a higher plutonium concentration. The influence of the calcination/reduction temperature and compacting pressure on the density before and after sintering was studied. According to the results of the experiments, the density after calcination is not significantly affected by these two variables when the calcination/reduction temperature is over 500 C. Author

N70-25096# Groupement Atomique Alsacienne Atlantique, Le Plessis-Robinson (France).
THREE-DIMENSIONAL CALCULATION OF POWER DENSITIES AND TEMPERATURES IN A GAS-GRAPHITE REACTOR. PART 1: THEORY. PART 2: PROGRAMMING USES. PART 3: COMPARISON WITH EXPERIMENTAL RESULTS Final Report [CALCUL TRIDIMENSIONNEL DES DENSITES DE PUISSANCE ET DES TEMPERATURES DANS UN REACTEUR GRAPHITE-GAZ, PARTIE 1: THEORIE. PARTIE 2: PROGRAMMATION, NOTICES D'EXPLOITATION. PARTIE 3: COMPARAISON AVEC LES RESULTATS EXPERIMENTAUX, RAPPORT FINAL]
M. Pages, J. L. Picou, and G. Veilhan Brussels EURATOM 1969 130 p refs In FRENCH
(Contract EURATOM-100-66-9-TEGF)
(EUR-4385.F) Avail: CFSTI

The flux values and the efficiencies of control rods partly inserted in a gas-graphite power reactor were determined analytically by a method derived from that of Nordheim-Scalettar. The scheme adopted is that of a cylindrical homogeneous reactor, axially bare, with two multiplier zones and a radial blanket, and the analysis

is done by means of an expansion in axial harmonics. After determination of the reactivity of the individual components, characterized by their extrapolation distances, the temperatures are deduced from the local thermal flux normalized to the total reactor power. Two codes (MUTHER I and II), differing essentially in approximations to the heterogeneity boundaries, and the associated code (BARCEL) for calculating the extrapolation distances, were written in FORTRAN IV and perfected on the IBM 360/65 machine. A comparison was made with the values measured on the Italian Latina power reactor and French EDF-2 reactor. The differences between the theoretical and experimental values show that these codes give satisfactory results. Author

N70-25097# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
POLAROGRAPHIC ANALYSIS FOR Ni, Fe, AND Cr IN THE WATER OF THE PRIMARY CIRCUIT OF THE IFA, BUCHAREST, WWR-S REACTOR [L'ANALYSE POLAROGRAPHIQUE DE Ni, Fe, Cr DANS L'EAU DU CIRCUIT PRIMAIRE DU REACTEUR VVR-S IFA-BUCHAREST]
Zamfira Alexan 1969 4 p refs In FRENCH
(IFA-FR-75) Avail: CFSTI

The analysis of trace elements contained in the water of the primary circuit of a nuclear reactor is reported. The corrosion as well as the erosion of reactor materials which are in the vicinity of the irradiated water aid in the dissolution of radioactive elements which it contains. The shell and the metallic pipes where the water circulates are stainless steel which contain excesses of iron, chrome, and nickel which enter the reactor water. Primary circuit water was evaporated and the residue was analyzed. This analysis was performed after ten years of continuous run in the Bucharest research reactor. The quantitative analysis of these elements of polarographic methods is presented in tables. Author

N70-25129# Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium).
[RESEARCH ACTIVITIES] Annual Scientific Report, 1968
R. Billiau, L. Buyse, and H. Fredrix, eds. 1969 177 p refs
(NP-18052) Avail: CFSTI

Applied research continued to be devoted mainly to the fuel cycle, particularly in connection with the fast breeder project where it covered the study of carbide fuel, the development of a dispersion reinforced ferritic steel for fuel canning, and the reprocessing of high burnup fuel by fluorination. Plutonium recycling in light water reactors was further investigated; this included irradiation experiments in BR2 and BR3. In basic research, direct and permanent contacts were maintained or established with the staff of several Belgian Universities. Some work was devoted to activities of public interest. Research on safeguard techniques was also included. Author

N70-25145# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
SORA DYNAMICS AND CONTROL SYSTEM STUDIES USING MEAN-VALUE NEUTRON KINETICS EQUATIONS
R. Arhan 1970 95 p refs
(EUR-4408 E) Avail: CFSTI

Dynamics and control of the pulsed fast reactor SORA are discussed based on a set of equations for mean-value neutron kinetics. A simulation of the complete set of equations, including thermal reactivity feed-back, is performed. The reactor responses to perturbations of reactivity, inlet coolant temperature and coolant velocity are shown. Control rod malfunctions are investigated and a start-up procedure is proposed. A fast control system is synthesized. Author

N70-25152# Academia R. S. R., Bucharest. Inst. de Fizica Atomica.
ANALYSIS OF HYDROGEN PEROXIDE AND OXYGEN IN THE COOLING CIRCUIT OF THE WWR-S REACTOR [L'ANALYSE DE L'EAU OXYGENEE ET DE L'OXYGENE DANS LE CIRCUIT DE REFROIDISSEMENT DU REACTEUR VVR-S]
Zamfira Alexan 1969 5 p refs In FRENCH
(IFA-FR-76) Avail: CFSTI

The concentrations of hydrogen peroxide and oxygen in the cooling circuits of water cooled reactors were determined. A polarographic method was used to make the determinations. This analysis was made to prevent the corrosion of metal materials of these circuits. Transl. by J.M.C.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-23909# Naval Research Lab., Washington, D.C.
ANGULAR SCATTERING FUNCTIONS FOR SPHERICAL WATER DROPLETS
H. B. Howell 8 Oct. 1969 119 p refs
(AD-698492; NRL-6955) Avail: CFSTI CSCL 20/6

Tables and graphs are presented which give the angular distribution of scattered light from spherical particles having a refractive index 1.33 (e.g., water droplets in air). The 50 particle sizes include the size parameters 1(1)20, 22(2)50, 55(5)125, and the scattering angles 0(0.2)180 deg. in the graphs and 0(2)180 deg. in the tables. The computational procedure is given in detail, and the FORTRAN programs are listed. Author (TAB)

N70-23971# Akademiya Nauk URSR, Kiev.
ON THE QUESTION OF ERRORS IN DETERMINING COERCIVE FORCE
S. G. Taranov and N. Ye. Fevraleva *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 142-150 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

Errors which occur when measuring coercive force in ferromagnetics are analyzed. The method of nulling remnant magnetization is assumed, in which case errors arise from inaccurate measurements of the demagnetizing field and the exact null condition in a test specimen. Ways of reducing the errors are suggested. A table of magnetic properties is given for several core materials of the AN, Alnico, and Ticonal types. Further analytical data are given which apply to the general cases of low and high permeability materials. Transl. by B.E.S.

N70-23975# Akademiya Nauk URSR, Kiev.
EFFECT OF MAGNETIC VISCOSITY AND NONUNIFORM MAGNETIC PROPERTIES ON COERCIVITY MEASUREMENTS
Ye. A. Andriyevskiy and Ye. F. Nekokrytyy *In its* Analysis of Electromeasuring and Magnetomeasuring Devices 1967 p 171-178 refs In RUSSIAN (See N70-23951 11-09)
Avail: CFSTI

The erroneous effect of magnetic viscosity is treated with respect to measurements of dc magnetic devices. Since induced fields are not formed instantaneously, but in some cases on the order of minutes, magnetic parameter measurements may have a time-factor error. Test data are given for six different magnets of the YuND alloy type which show variation of field intensity with time. Coercive fields were in the range of 419 to 762 e. It is concluded that possible error from magnetic viscosity should be considered in precise magnetic measurements. Transl. by B.E.S.

N70-24084*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF TEMPERATURE-PROFILE VARIATION ON

REFRACTION OF SOUND BY JET FLOW
Jay C. Hardin Washington Apr. 1970 29 p refs
(NASA-TN-D-5779) Avail: CFSTI CSCL 20A

The techniques of geometrical acoustics are employed to study the effect of variation of the jet-temperature profile upon propagation of sound in the jet. It is shown that the temperature profile of the jet can be shaped to cause the jet flow to act as a channel for the sound. Further, a simple analytical expression which predicts the occurrence of such phenomena in a nonspreading jet is obtained. This expression also seems to be approximately valid for a spreading jet. Author

N70-24193# Naval Research Lab., Washington, D.C.
SIMULATION STUDY OF A SYSTEM FOR MEASURING DIRECTIVITY INDEX Interim Report
Lynn B. Poche 26 Dec. 1969 23 p refs
(AD-699153; NRL-7026) Avail: CFSTI CSCL 20/1

In a proposed directivity-index-measuring system, a semicircular array of hydrophones samples the acoustic power output of an underwater electroacoustic transducer; associated analog electronic circuitry and a digital computer yield a number representing the directivity index. The response of such a system to changes in geometric distribution of sampling points, number of points sampled, and complexity of directivity pattern has been studied by means of a computer-simulated model. Results show that the specified accuracy can be exceeded by using 11 hydrophones arranged to sample 396 equal areas of a spherical surface when the source is a plane, circular piston ($ka < or = 10$) radiating in an infinite baffle. Limits consistent with the required accuracy also were established for potential sources of error within the system (projector misalignment, finite sampling time, dynamic range, and conversion nonlinearity). Author (TAB)

N70-24205# California Univ., Berkeley. Lawrence Radiation Lab.
ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS
Y. R. Shen Oct. 1969 25 p refs Presented at the Ceramics Conf., Gainesville, Fla.
(Contract W-7405-eng-48)
(UCRL-19089; CONF-691111-1) Avail: CFSTI

Theories of electro- and magneto-effects are reviewed. Symmetry argument for finding independent and nonvanishing components of the electro- and magneto-optical tensor coefficients is briefly described. Emphasis is on the recent development of the microscopic theories which predict quite accurately the magnitudes of these nonvanishing components. Author (NSA)

N70-24284# Brown Univ., Providence, R.I. Div. of Engineering.
PROPAGATION OF SOUND THROUGH ATMOSPHERIC FOG
John E. Cole, III and Richard A. Dobbins Dec. 1969 37 p refs
(Contract N00014-67-A-0191-0001)
(AD-699188) Avail: CFSTI CSCL 20/1

The propagation of sound in an atmospheric fog is described by considering a system of liquid droplets suspended in a mixture of their vapor and an inert gas. The perturbation of this system by a sound field causes the droplets to exchange mass, momentum, and heat with the surrounding gaseous mixture and results in acoustic attenuation and dispersion. Strong attenuation per unit wavelength due to mass transfer effects is predicted in the subaudible (infrasonic) region in which signals from weather fronts and atmospheric explosions are monitored. Dimensional attenuation is found to be nearly constant both for low audible frequencies and for high frequencies. The level of dimensional attenuation for the high frequencies is approximately six times that at the low frequency level. Transition from the low level to the high level of attenuation depends on fog particle size. Computed results for typical fog data are given, and optimal signaling frequencies are discussed. Author (TAB)

N70-24277*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INTERFEROGRAMS OF WINDOW WAVEFRONT DEFORMATIONS AS A MEASURE OF ANGULAR DEVIATIONS TO A LINE OF SIGHT
Thomas M. Walsh and David N. Warner, Jr. Washington Apr. 1970 14 p refs
(NASA-TN-D-5749; A-3074) Avail: CFSTI CSCL 20F

An interferogram of the wavefront deformation to a flat wave caused by an aircraft or spacecraft window contains all the error contribution effects of the window. The interferogram may be analyzed to determine the slope of this wavefront at a given point, which yields the angular deviation to a line of sight through the point. The interferogram as used in this study is a two-dimensional photo representing the three-dimensional relationship of the transmitted wave relative to the flat reference wave. The progression from light to dark fringes is the progression of the third dimension normal to the photo, and the fringes are thus similar to contour lines on a topographic map. To demonstrate the ability to obtain interferograms, to analyze interferograms, and to achieve sufficient accuracy, an aircraft window and spacecraft window were studied in an experimental test. The deviations to a line of sight were derived from transmitted wave interferograms obtained in the laboratory and were also measured precisely by an autocollimator system. The standard deviation of the transmitted wave deviations derived from interferograms relative to directly measured deviations was 0.7 second of arc, indicating that the transmitted wave interferogram method is a good tool for window error determination. Author

N70-24362 Polytechnic Inst. of Brooklyn, N.Y.
COHERENCE IN INTERACTING FIELDS
Ami Kestenbaum (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-20343

The structure and time evolutionary characteristics of this function and related phase-space distributions for two physical processes of interest constitute the major effort of this dissertation. The form of the P-representation for an electromagnetic field interacting with a two level system is examined. For the case where there are initially more atoms in the lower of the two energy levels, the P-representation for an initially coherent field is obtained, and spontaneous emission obliterates the coherent properties, resulting in pure noise in the steady state. The effects of internal phase modulation on the coherent properties of the field are also studied. Assuming that the linear electrooptic effect provides the actual mechanism for coupling the modes, the operators' equations of motion for resonant modulation (modulation at a frequency precisely equal to the intermode spacing), and non-resonant modulation (modulation at a frequency slightly different from the intermode spacing are derived and solved). Dissert. Abstr.

N70-24380# California Univ., Berkeley. Electronics Research Lab.
SIGNAL PROCESSING OF MICROWAVES SCATTERED FROM WATER
J. Comeau and D. J. Angelakos 1 Oct. 1969 77 p refs
(Contract Nonr-3656(11))
(AD-699506; ERL-69-8) Avail: CFSTI CSCL 20/1

It has been shown possible to detect low frequency sound waves in water through 8mm microwave scattering from the water surfaces. It was the purpose of this project to improve the sensitivity of signal detection by improving the signal processing method. Three steps were taken to improve on the work previously done: (1) the implementation of the Berkeley Array Processor to greatly lessen the computation time, (2) the improvement of noise-rejection by performing autocorrelation on the sample prior to fast fourier transformation, (3) the inclusion of a 30 Hz high-pass filter to remove wind noise. It was found that the implementation of these three steps did improve the sensitivity of detection by a significant margin. Author (TAB)

N70-24408# National Physical Lab., Teddington (England). Aerodynamics Div.
RANGE PREDICTION FOR SIREN SOURCES
M. E. Delany Nov. 1969 77 p refs
(NPL-AERO-SR-033) Copyright. Avail: CFSTI

The propagation of 400 Hz sound from an elevated source over rural, suburban, and urban areas is considered. Factors important in rural propagation include refraction, scattering, ground absorption, air attenuation, and screening by obstructions; a general prediction scheme incorporating most of these is shown to be in reasonable accord with available field data. By introducing a screening factor which depends on the degree of urbanization, available field data on urban propagation from a source erected above roof-top level are also found to be consistent. Minimum sound pressure levels required either to effect audible warning or to be just audible above typical ambient noise levels are suggested. For dense urban areas the possible advantages of street-by-street coverage using a number of lower-powered sources erected below roof-top level are briefly discussed. Author (ESRO)

N70-24496# Ohio State Univ., Columbus. Electroscience Lab.
ASYMPTOTIC SERIES DESCRIBING THE DIFFRACTION OF A PLANE WAVE BY A WEDGE Scientific Interim Report
David L. Hutchins and Robert G. Kouyoumjian 15 Dec. 1969 158 p refs
(Contract AF 19(628)-5929)
(AD-699228; Rept-2183-3; AFCRL-69-0412) Avail: CFSTI CSCL 20/14

The Pauli and the Oberhettinger asymptotic expansions for the diffracted field produced by the scattering of a plane electromagnetic wave by a wedge are compared analytically and numerically, and their range of application is extended. The Pauli-Clemmow method of steepest descents is used to evaluate Sommerfelds complex integral expression for the total field produced by the scattering of a plane electromagnetic wave by a perfectly conducting wedge. This method is applied in a manner somewhat different from that employed by Pauli and yields an asymptotic expansion which is simpler in form and of wider applicability than Paulis original expression. This generalized form of Paulis expansion can, for example, be applied to the computation of the fields diffracted by wedges which have exterior angles less than 180 degrees. It is shown that simply by rearranging the terms in this generalized Pauli expansion a generalized form of Oberhettingers asymptotic expansion can be produced. The superiority of the generalized Pauliasymptotic expression over previously derived asymptotic expressions is demonstrated in numerical examples. These asymptotic expressions are used to obtain scalar diffraction coefficients which are valid in the transition regions at the shadow and reflection boundaries. Author (TAB)

N70-24607# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TIME-HARMONIC WAVES TRAVELING OBLIQUELY IN A PERIODICALLY LAMINATED MEDIUM Technical Report, Oct. 1968 - Jun. 1969
C. Sve 1 Jan. 1969 29 p refs
(Contract F04701-69-C-0066)
(AD-698328; TR-0066(5240-30)-2; SAMSO-TR-69-356) Avail: CFSTI CSCL 20/11

The dispersion relation is presented for time-harmonic waves propagating in an arbitrary direction in a periodically laminated medium. The analysis is based on two-dimensional equations of elasticity. Limiting phase velocities are presented for infinite wavelength for any angle of propagation in the form of a fourth-order determinant that illustrates the influence of an arbitrary angle. For the cases when the propagation is along or across the layers, the determinant reduces to two determinants of second order that yield the limiting phase velocities directly. Numerical results are presented to indicate the dependence of dispersion upon the angle of propagation. Also, a comparison with an approximate continuum theory is included; agreement is satisfactory for those angles where the dispersion is the strongest. Author (TAB)

N70-24910# Iowa State Univ. of Science and Technology, Ames.
CONTRIBUTION TO THE THEORY OF OPTICAL REFLECTION AT A METAL SURFACE
Joseph M. Keller Oct. 1969 26 p refs
(Contract W-7405-eng-82)
(IS-2194) Avail: CFSTI

Kliewer and Fuchs have formulated a theory for optical reflection at the surface of a free electron metal, including consideration of the nonlocal nature of the conductivity. For the case of p polarization and diffuse scattering of electrons at the surface, the theory leads to a set of three coupled integro-differential equations. The major part of this report is a study properties of the kernels of these equations. By using these properties the equations may be reduced to two uncoupled equations, one of which can be solved, at least formally, by the Wiener – Hopf technique. An expression for the surface impedance of the metal has not been determined. NSA

N70-25001# France. Ministere de l'Air, Paris.
NOTE ON THE PRINCIPLES OF CLASSICAL MECHANICS AND THERMODYNAMICS [NOTE SUR LES PRINCIPES DE LA MECANIQUE ET DE LA THERMODYNAMIQUE CLASSIQUES]
Marcel Wanner 1969 60 p refs In FRENCH
(Rept-450) Avail: CFSTI

The classic principles of mechanics and thermodynamics of macroscopic material groups from a mathematical viewpoint are considered. The idea of point functions, material points, and forces between two material points is explored. Group functions, material groups, and reciprocal actions between group materials are obtained. Emphasis is placed on the effect of interior forces in the material groups. Transl. by J.M.C.

N70-25041 Catholic Univ. of America, Washington, D.C.
A CREEPING WAVE DESCRIPTION OF SOUND SCATTERING FROM ELASTIC CYLINDERS
Richard Darl Doolittle (Ph.D. Thesis) 1968 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-8920

The problem of sound scattering from an infinite elastic circular cylinder is treated by performing the Sommerfeld – Watson transformation on the normal mode solution. Through this process an interpretation of scattering in terms of creeping waves is evolved. The complex velocities of these waves are found from the roots of a three-by-three determinant obtained by the boundary conditions at the surface of the body. These zeros are determined numerically. There are two types for the case of the metallic cylinder, subsonic diffraction (Franz) waves and supersonic surface (Rayleigh) waves. Only one of the Franz wave modes was found to be numerically significant while two and possibly more Rayleigh modes contribute to the scattered field. The number of allowed Rayleigh modes increases with the parameter ka. It is found that the intuitive picture of waves being launched at a critical angle, traveling on the surface to a point at the same angle with respect to the observer and then leaving again at that angle is not accurately borne out in the analysis since the critical angles are complex. The presence of multiple returns from a single incident pulse observed by several experimenters is explained by the analysis presented in this work. Numerical calculations include bistatic scattering cross section for an aluminum cylinder in the range ka 4.8 to 6.0 which compares well with experimental values. Dissert. Abstr.

N70-25060# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
THE ACOUSTICAL SOURCE IN A TWO-DIMENSIONAL JET
E. W. Graham and B. B. Graham Sep. 1969 26 p refs
(D1-82-0909) Avail: CFSTI

An acoustical point source moving with the local fluid in a two-dimensional jet of infinite length is studied. In particular, the effect of linear velocity profile shear layers separating the uniform

jet from the external fluid is studied. Comparison of shear layer jets with jets bounded by velocity discontinuities can show significant differences in far field mean-square pressures. Possible causes of these differences are discussed. For the supersonic jet, far field effects are confined to a downstream Mach cone. Pressures on the Mach cone are calculated to be zero for the velocity discontinuity jet. Author

N70-25111# Atomic Energy Commission, Washington, D.C.
ON THE POSSIBILITY OF AMPLIFYING ELECTROMAGNETIC RADIATION THROUGH THE USE OF AVERAGED HIGH-FREQUENCY FIELD FORCES
G. S. Lukyanchikov [1969] 4 p refs Transl. into ENGLISH from Russian report NP-18007
(AEC-tr-7117; NP-18007) Avail: CFSTI

An average force acts on a charge placed in a variable electric field. It is shown that it is possible to have an increase in energy of the electromagnetic field with a charge moving through a high-frequency field. The particle in its oscillatory motion continually moves towards the electric field of the standing wave. An expression is given for the relative increase in power per unit length which is quite small. However, it is possible to increase the power by orders of magnitude by proper selection of the magnetic field and frequency. The method has advantages (no limitation due to space charge) in producing short-wavelength radiation. NSA

N70-25139# Aztec School of Languages, Inc., Maynard, Mass.
MEASUREMENT OF ABSORPTION IN SEA WATER OF LIGHT TRANSMITTED VERTICALLY AND HORIZONTALLY AT VARYING DEPTHS BY AN ARTIFICIAL SOURCE [MESURE DE L'ABSORPTION, DANS L'EAU DE MER, DE LA LUMIERE EMISE PAR UNE SOURCE ARTIFICIELLE, A DIVERSES PROFONDEURS, VERTICALEMENT ET HORIZONTALEMENT]
Jacques-Ives Cousteau et al Dec. 1969 28 p refs Transl. into ENGLISH from Bull. Inst. Oceanogr. Monaco, v. 63, 1964 17 p
Prepared for Lincoln Lab., MIT
(AZT-69-625-FRLL) Avail: CFSTI

The absorption by sea water of light transmitted by an artificial source located at varying depths down to 250 meters was studied. All aspects of propagation of natural light (polarization, angular distribution, scattering, absorption especially in the ultraviolet range) were included. The measurements were performed on board a self-contained exploration vehicle, the diving saucer, as well as the research vessel, the Calypso, in the Bay of Corsica. The penetration measurements of artificial light horizontally into sea water at different depths have shown that levels of different coefficients of absorption are found depending on the depth. At certain levels, phenomena of a biological nature temporarily modify the transparency of the water. These experiments open a new field for the use of underwater vehicles for undersea exploration. Author

N70-25178# Akademiya Nauk URSR, Kiev.
A GEOMETRIC REPRESENTATION OF THE STATES OF A PERMANENT MAGNET WHEN DESIGNING LINEAR MAGNETIC CIRCUITS
V. V. Kozorez *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 128–132 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

The existing methods of designing magnetic circuits with permanent magnets are based on the use of an operating diagram, which permits the coupling between the magnet's parameters and those of other sections of the magnetic circuit. When designing magnetic circuits with permanent magnets the operating diagram is used as a sort of geometric field, each point of which corresponds to a definite state of the magnet. A method designing is presented which is based on a geometric representation of the state of magnet which differs from the usual representation. This permits a more complete interpretation of the magnetic field. Transl. by H.W.

N70-25183# Akademiya Nauk URSR, Kiev.
USING THE EFFECT OF MAGNETIC RESISTANCE TO MEASURE THE INDUCTION OF VARIABLE MAGNETIC FIELDS
Ye. A. Andriyevskiy, Yu. M. Panchishin, and S. G. Taranov *In its* Increasing the Precision and Automating Elec. and Magnetic Measuring Devices 1968 p 158–164 refs In RUSSIAN (See N70-25158 11-09)
Avail: CFSTI

Highly precise measurements of variables can be achieved in devices which use the method of comparing an unknown signal to a constant signal which is equivalent to it. A device for detecting magnetic resistance can be used as the element, serving as the comparator converter, which measures the effective value of the induction of the variable magnetic fields. The operation of the comparator is studied and its precision is given. The analysis shows that the circuits permit an actual increase in the precision of determining the induction of variable magnetic fields. The calculations permit the evaluation of certain errors found in the devices. Transl. by H.W.

N70-25203# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
DEPTH OF FIELD LIMITATIONS ON THE PERFORMANCE OF IMAGING SYSTEMS
Pythagoras Cutchis Oct. 1969 14 p refs
(Contract DAHC15-67-C-0011)
(AD-699130; N-668(R); IDA/HQ-69-10831) Avail: CFSTI
CSCL 20/6

The near and far depths of field of an optical system are related to the performance to be expected from an imaging system. The near and far ranges beyond which depth of field imposes an unacceptable degradation in imagery are plotted as a function of the ratio of the diameter of the circle of confusion to the diameter of the aperture. Hyperfocal distance is plotted as a function of resolution in line pairs per millimeter with f-number as a parameter. A hyperfocal distance criterion for acceptability of a fixed focal length system is derived as a function of near and far field ranges of interest. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-23916# Notre Dame Univ., Ind. Dept. of Physics.
POSSIBLE SCHEME FOR ANALYZING DIRECT NUCLEAR REACTIONS
Paul E. Shanley [1969] 12 p refs
(Contract AT(11-1)-427)
(COO-427-96) Avail: CFSTI

A technique of data analysis familiar in nucleon-nucleon scattering is proposed for use in the extraction of spectroscopic information from direct nuclear reactions. The method is shown to be successful in analyzing some artificial data generated by a soluble three-body model of deuteron stripping. Author (NSA)

N70-23917# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
PMSI: A FORTRAN MONTE CARLO CODE FOR CORRECTING EXPERIMENTAL FAST-NEUTRON POLARIZATION DATA

G. W. Morrison, T. G. Miller, and F. P. Gibson 12 Dec. 1969 32 p refs
(Contract W-7405-eng-26)
(CTC-9) Avail: CFSTI

A Monte Carlo Code was written to correct experimental fast neutron polarization data for finite geometry and multiple scattering effects, when liquid helium is the polarizer analyzer. The code uses phase shifts to calculate the necessary parameters, the angular distribution, the polarization and the spin rotation parameter needed for consistent tracking of polarization effects in successive scatterings. The code adjusts the initial input polarization needed to reproduce the measured left-right ratio. Author (NSA)

N70-23918# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
IRRADIATED RADIUM-BERYLLIUM NEUTRON SOURCE BUILDUP
S. W. Kitchen and D. C. Sherman Oct. 1969 21 p refs Presented at the 17th Conf. on Remote Systems Tech., San Francisco
(Contract W-31-109-eng-52)
(KAPL-P-3849; CONF-691102-4) Avail: CFSTI

Large increases in neutron source strength as a result of irradiation by neutrons were first reported in 1958. Later experimental work irradiating sources in the Materials Test Reactor indicated that resonance absorption effects could be safely ignored. Consideration of the differences in neutron energy spectrum between the MTR and usual power reactors suggested that resonant absorption effects could be significant in power reactors. Calculations over a range of neutron spectra show the source buildup factor to be several times as large for spectra typical of power reactors as that for purely thermal reactors. Author (NSA)

N70-23922*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RAREFIED DIFFUSION BY MODEL SAMPLING
Morris Perlmutter Washington Apr. 1970 20 p refs
(NASA-TN-D-5764) Avail: CFSTI CSCL 20H

The rarefied diffusion of molecules of species alpha, evaporated or emitted from one plate, through another molecular species beta enclosed between parallel walls is analyzed by model sampling. The diffusing species is sufficiently dilute so that only collisions with nondiffusing molecules are important. Maxwellian collisions are assumed. The results are given over a Knudsen range from free molecule to continuum flow. These results fall along one curve for all molecular mass ratios when the appropriate definition of mean free path is used. The results agreed with the continuum solution and slip theory was found to give reasonable approximate results. Author

N70-23936# Chicago Univ., Ill. Enrico Fermi Inst.
GENERALIZED VECTOR DOMINANCE THEORY AND VERTEX FUNCTIONS
P. H. Frampton Oct. 1969 53 p refs
(Contract AT(11-1)-264)
(COO-264-525; EFI-69-92) Avail: CFSTI

A simple model formula for the hadronic form factors as a ratio to two gamma functions is examined from the point of view of its consistency with the beta function model and with the chiral properties of the vector and axial-vector currents. It is shown that similar models may hold simultaneously for the simplest vector and axial-vector form factors while maintaining consistency with the Veneziano model of the four-point function, and with the requirements of a conserved vector current, partially conserved axial-vector current and the Gell-Mann algebra of currents. An infinite class of such solutions is found. Scalar and pseudoscalar form factors are treated also, with similar results. In order to consider matrix elements of the vector and axial-vector current operators between other hadron states generalized field-current identities are written, and a universality hypothesis that the vector mesons and their higher recurrences couple universally to the independent helicity amplitudes of the Breit frame is made. Author (NSA)

N70-23937# Oak Ridge National Lab., Tenn. Isotope Information Center.
ACTIVATION ANALYSIS WITH CHARGED PARTICLES AND GAMMA PHOTONS
Ch. Engelmann Sep. 1969 7 p refs Transl. into ENGLISH from Bull. Inform. Sci. Tech. (Paris), no. 140, 1969 p 65–70 Sponsored by AEC
(ORNL-tr-2265) Avail: CFSTI

Many elements can be determined by activation both by charged particles (alpha, deutrons, protons, tritons, etc.) and by gamma photons. The methods are simple, fast, sometimes nondestructive and in certain cases allow the localization of impurities. The methods are particularly useful for the determination of light elements, such as B, C, N, O, F in relative concentrations of 10 to the −9th power. In addition the fact that the samples can be cleaned to the desired depth after irradiation and before measurement excludes any risk of pollution. These methods are therefore exceptionally useful for the analysis of extremely pure materials. Author (NSA)

N70-23943# Washington Univ., Seattle. Dept. of Physics.
ELASTIC SCATTERING OF ALPHA PARTICLES BY INTERMEDIATE MASS NUCLEI
B. Fernandez and J. S. Blair 1969 52 p refs
(RLO-1388-106) Avail: CFSTI

Angular distributions of 42-MeV alpha particles, elastically scattered from Ca-40, 42, 44, 48, Ti-46, 48, 50, Cr-52, Fe-54, 56, and Ni-58, 60, 62 were measured in the forward region with an absolute accuracy of + or − 0.1 deg; in particular, the locations of the minima near 35 deg (center of mass system) were determined to within + or − 0.1 deg. The theoretical analysis was done in three ways using: (a) the Fraunhofer model, (b) a direct parameterization of the scattering amplitude in terms of 3 parameters, and (c) a standard four parameter optical model. Strong absorption radii were deduced from the critical angular momenta extracted from the scattering amplitudes. In addition attempts were made to determine, for the optical model analysis, other sorts of strong absorption radii which are more characteristic of the scattering than the usual midpoint radius of the potential. The analyses indicate that the rate of increase of almost all such strong absorption radii is smaller within the Ca isotopes and within the Ti isotopes than within the Fe and Ni isotopes, the radius of Ca-48 being anomalously small in all but one type of analysis. Author (NSA)

N70-23978# Brookhaven National Lab., Upton, N.Y.
STUDIES OF THE (n, GAMMA) REACTION WITH A NEUTRON MONOCHROMATOR
W. R. Kane, D. Gardner, T. Brown, A. Kevey, E. der Mateosian et al 30 Oct. 1969 12 p refs Presented at the Intern. Symp. on Neutron-Capture Gamma-Ray Spectroscopy, Studsvik, Sweden, 11-15 Aug. 1969 Sponsored by AEC
(BNL-14110; CONF-690802-3) Avail: CFSTI

A crystal diffraction neutron monochromator was constructed specifically for studies of the (n,gamma) reaction. This equipment plays a complementary role to that of time-of-flight devices in providing a neutron beam with a full duty cycle at a given energy. This feature and the small target size, large geometrical efficiency for gamma-ray detection, and negligible fast neutron background afford advantages for certain classes of experiments. The useful energy range extends from 0.01 to 20 eV. Novel features of the equipment include a complete reliance upon precision angle encoders for setting arm and crystal angles, the employment of a liquid shield to facilitate the extraction of the diffracted neutron beam, and the use of air bearings to provide for the motion of the target, detection devices, and associated shielding. Results obtained on low energy resonances of La-139, Os-189, and U-235 are presented. Author (NSA)

N70-24000# Stanford Linear Accelerator Center, Calif.
DETERMINATION OF THE TRANSVERSE POLARIZATION OF HIGH-ENERGY ELECTRONS
V. N. Baier et al. [1969] 10 p refs Transl. into ENGLISH from Yadern. Fiz. (Novosibirsk), v. 9, no. 2, 1969 p 409–412
(SLAC-Trans-107) Avail: CFSTI

Various possible experimental methods for determining the degree of transverse polarization of high-energy electrons in storage rings are briefly discussed. NSA

N70-24008# Washington Univ., Seattle.
SPONTANEOUS FISSION ISOMERS
Kevin L. Wolf (Ph.D. Thesis) 1969 83 p refs
(RLO-1388-107) Avail: CFSTI

A search for spontaneous fission isomers was made, chiefly in the plutonium isotopes, by bombarding uranium targets with 21- to 42-MeV helium ions. A system that is capable of direct electronic measurement of fission half-lives as short as two nanoseconds was developed. Three plutonium isomers were identified. These isomers and their half-lives are Pu-240m (t sub 1/2 = 4.4 + or − 0.8 nsec), Pu-239m(t sub 1/2 > or = 400 nsec), and Pu-237m(t sub 1/2 = 120 + or − 30 nsec). Absolute cross sections were determined for the production of each isomer. From the cross sections, an indirect method was used to determine the isomeric excitation energies relative to the ground states of these nuclei. These isomers were interpreted in terms of metastable states associated with double-humped fission barriers. The half-life and excitation energy results, along with the known ground-state spontaneous fission half-life and the height of the fission barrier, were used in calculations that give a consistent one-dimensional interpretation of the fission barrier for the even-even nucleus Pu-240.
Author (NSA)

N70-24013# Los Alamos Scientific Lab., N. Mex.
MOLECULAR BEAMS FROM LONG PARALLEL TUBES
John P. Brainard 5 May 1969 6 p refs
(Contract W-7405-eng-36)
(LA-4280) Avail: CFSTI

Molecular beams from long parallel tubes, a new development in beam formation, were investigated for use in a mass spectrometer. Gas-beam flux distributions from a glass-tube bundle, two collimated-hole structures, and a long single tube were measured. The distributions of the multichannel sources compared favorably with the theory of Giordmaine and Wang within the experimental error.
Author (NSA)

N70-24015# California Univ., Berkeley.
INELASTIC SCATTERING OF MOLECULAR IONS
Kuien-Hsiung Cheng Oct. 1969 84 p refs
(Contract W-7405-eng-48)
(UCRL-19108) Avail: CFSTI

An ion-beam-collision-cell method was used to measure the angular and energy distributions of NO(+) N(2) O(+), and D(2) O(+) inelastically scattered from He. A primary ion energy range of 35 to 200 eV was investigated. The angular distributions in the center of mass coordinate system were compared with two classical models; the hard-sphere collision model and the effective collision-energy model. The former gave an upper limit to the observed angular distributions. The effective collision energy method which made use of the breathing-sphere assumption for the diatomic molecule and employed an approximation similar to that of Takayanagi in the modified wave number approximation, gave results that agreed excellently with the experimentally measured angular distributions. The relative kinetic energy loss of inelastically scattered ions at 180 deg. (cms) agreed reasonably well with exact classical calculations for a collinear collision.
Author (NSA)

N70-24016# Los Alamos Scientific Lab., N.Mex.
SELF-CONSISTENT FIELD HARTREE CALCULATIONS FOR ATOMS AND IONS
Allen C. Larson and James T. Waber 21 Oct. 1969 169 p refs
(Contract W-7405-eng-36)
(LA-4297) Avail: CFSTI

The wave functions, eigenvalues, and values of r to the nth power were calculated, through use of the Hartree model, for more than 500 different configurations of atoms and ions from atomic numbers 1 to 128. The various assumptions used and many of the problems encountered in this type of calculation are discussed. Procedures are suggested to solve the problem of slow convergence encountered with atoms such as copper. The results for hydrogen-like ions obtained from the programs are compared with analytic numbers. The effect of the convergence criterion on the stability of solutions was examined for the series iron, nickel, and cobalt, and the results are discussed. On the computer used, the IBM 7094, a self-consistent test more stringent than .00001 failed to improve the expectation values significantly. Various effects of changing the assumed electronic configuration are examined.
Author (NSA)

N70-24028# California Univ., Livermore. Lawrence Radiation Lab.
INCIDENT ENERGY DEPENDENCE OF FISSION SPECTRA
R. J. Doyas and R. J. Howerton Sept. 1969 7 p refs
(UCRL-50755) Avail: CFSTI

Terrell's relationship for a fission neutron spectrum is E' (3/2) T sub m approximately 0.75 + 0.65[Upsilon(E) + 1], where E' is the mean energy of the emitted neutrons, T sub m is the corresponding Maxwellian temperature, and Upsilon is the average number of neutrons emitted in a fission event for incident neutrons of energy E. Previous comparisons of this equation with experimental results, which have shown considerable discrepancies and cast some doubt on the equation's validity, used a value of Upsilon(E) corresponding to the total emission of neutrons from a fission event. These comparisons are replotted here using a value of Upsilon(E) corresponding to only the fission-produced neutrons, and much better agreement is found between the Terrell equation and experiment. It is concluded that the equation gives a good description of E or T sub m for all incident energies between thermal and 14 MeV (and for spontaneous fission) and is applicable to all fissile isotopes.
Author (NSA)

N70-24029# California Univ., Berkeley. Lawrence Radiation Lab.
GAMMA SPECTRA FROM RADIATIVE PION CAPTURE IN CARBON
James A. Bistirlich, Kenneth M. Crowe, Anthony S. L. Parsons, Paul Skarek, and Peter Truoel Aug. 1969 7 p refs Presented at the 3rd Intern. Conf. on High Energy Phys. and Nucl. Struct., New York
(Contract W-7405-eng-48)
(UCRL-19349; CONF-690914-5) Avail: CFSTI

An experiment to study radiative capture of mesons on nuclei is described. The pair spectrometer study of the photon spectrum from hydrogen and carbon is shown, and the rates are given for He-4, Li-6, C-12, O-16, Mg-24, and Ca-40. NSA

N70-24030# California Univ., Berkeley. Lawrence Radiation Lab.
HANDLING FIELD NONLINEARITIES IN THE BEVATRON RESONANT EXTRACTION
Robert W. Allison, Jr., H. A. Grunder, and Glen R. Lambertson 18 Aug. 1969 17 p refs Presented at the 7th Intern. Conf. on High Energy Accelerators, Moscow
(Contract W-7405-eng-48)
(UCRL-19213; CONF-690811-12) Avail: CFSTI

In the development of a resonant extraction system for the Bevatron it is necessary to consider the effects of the strong nonlinearities in the synchrotron guide field. The variation of particle oscillation frequency with amplitude and distortions from sinusoidal form were analyzed. Effects on the resonant growth process were calculated and observed. Guided by the analysis, it

was possible to achieve satisfactory behavior with only minor alterations of the guide field. Use of a small spill-control perturbation is discussed and performance of the extraction system is reported. Author (NSA)

N70-24045# Illinois Univ., Urbana. Dept. of Physics.
COMMENTS ON THE LETTER EVIDENCE OF QUARKS IN AIR-SHOWER CORES
Hans Frauenfelder, U. E. Kruse, and R. D. Sard Nov. 1969 9 p refs
(COO-1195-173) Avail: CFSTI

The quark tracks, observed by McCusker and coworkers in cloud chambers can be explained by making reasonable assumptions about two processes: fluctuations in the number of droplets in a cloud chamber track, and the relativistic rise of the ionization. However, before a firm conclusion can be drawn, more experimental data on the drop count distribution of a large sample of tracks in the experiment are needed. Author (NSA)

N70-24070# Texas A&M Research Foundation, College Station.
EVALUATION OF A HIGH SPECIFIC ACTIVITY Co 60 SOURCE USED IN A GAMMA MONOCHROMETER
John A. McIntyry 25 May 1969 18 p refs
(Contract AT(40-1)-3410)
(ORO-662) Avail: CFSTI

A 40,000 curie cobalt-60 source in a gamma monochromator was evaluated. The 1.33 and 1.17 MeV gamma radiation leaving the source scatter from the scatterer by the Compton scattering process. Two types of research have been pursued using this variable-energy gamma beam. The gamma radiation was used to excite nuclear energy levels through the resonance fluorescence process. The character of the gamma radiation produced by the Compton scattering process was studied. The target was removed and a Ge(Li) solid state detector was put in its place. The pulse height distribution of the detector then yielded the energy distribution of the scattered gamma radiation. A description of the source and container is given. NSA

N70-24071# Northwestern Univ., Evanston, Ill. Dept. of Physics.
ON THE DERIVATION OF THE BELL HIROTA REPRESENTATION OF THE PARTITION FUNCTION FOR INTERACTING BOSONS Technical Report
J. B. Jalickee and F. W. Wiegel 26 Nov. 1969 13 p refs
(Contract N00014-67-A-0356-0002)
(AD-699176; TR-II-3) Avail: CFSTI CSCL 20/8

A simple representation of the partition function for interacting bosons was derived by Bell and Hirota. They used methods of second quantization, and the equivalence between Matsubara averages and averages over Gaussian random functions. The paper gives a derivation of this representation which entirely by-passes the formalism of second quantization, and uses methods of functional calculus only. Author (TAB)

N70-24074# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
PHENOMENOLOGICAL DUALITY
S. Kovesi-Domokos 25 Nov. 1969 44 p refs
(Contract AT(30-1)-4076)
(NYO-4076-4) Avail: CFSTI

The history and present status of phenomenological duality is summarized. The results and phenomenological justification are considered. Analyticity and Regge behavior for the finite-energy sum rules, the Dolen – Schmid and phenomenological duality, the separation of the Pomeranchuk and the background, and exotic states and exchange degeneracy are discussed. NSA

N70-24101# Chicago Univ., Ill. Enrico Fermi Inst.
MASS DEPENDENCE OF THE DIFFRACTION PEAK IN RESONANCE PRODUCTION AND THE MULTIPOINT VENEZIANO MODEL
Ronald E. Waltz Oct. 1969 12 p refs Sponsored by AEC
(COO-264-521; EFI-69-87) Avail: CFSTI

It is shown that the multipoint Veneziano model predicts that the diffraction peak in resonance production should smoothly broaden as the resonance mass increases in qualitative agreement with experiment. Comparisons with "nondual" models are made. Author (NSA)

N70-24103# California Univ., Livermore. Lawrence Radiation Lab.
VARIATION IN THE TOTAL RADIATIVE WIDTH GAMMA(SUB GAMMA) AS A FUNCTION OF THE MASS NUMBER A AND VALUE OF THE SPIN J = + OR − 1/2
J. Julien, R. Alves, S. de Barros, V. D. Huynh, J. Morgenstern et al Oct. 1969 58 p refs Transl. into ENGLISH from Nucl. Phys., v. 132, 1969 p 129 – 160 Prepared by Addis Translation International
(UCRL-TRANS-10397) Avail: CFSTI

Values of the total radiative width were measured for about 50 nuclei. Experiments were performed with the Saclay linear accelerator using the time-of-flight method. For some nuclei, total radiative width is not constant from resonance to resonance. It is shown that variation of total radiative width is due to the strong intensity of favored transitions for one spin state. A relation giving the value of the partial radiative width is deduced from platinum results. It is applied to other nuclei to interprat the total radiative width variations (Hg, Sn, Zr, Nb...). Author (NSA)

N70-24108# Syracuse Univ. N.Y. Dept. of Physics.
TWO VARIABLE EXPANSION OF THE SCATTERING AMPLITUDE FOR ANY MASS AND SPIN AND CROSS SYMMETRY FOR PARTIAL WAVES
A. P. Balachandran, W. Case, and M. Modjtehedzadeh Oct. 1969 21 p refs Sponsored by AEC
(SU-1206-209; NYO-2399-209) Avail: CFSTI

An infinite number of sum rules are derived for the process a + b yields c + d where a, b, c, d, are particles of arbitrary mass and spin. Each of the sum rules involves a finite number of partial waves. They are implied by the crossing symmetry of the system and are complete. A classification of these relations into an independent set suggests a basis for the two variable expansion of the scattering amplitude. The basis has the further virtue that it explicitly displays the threshold and pseudothreshold zeroes of the partial waves. The formalism is also valid for a decay process. The partial waves in the sum rules then refer to amplitudes where two of the three final particles are in a state of definite angular momentum while the region of expansion becomes the Dalitz plot. Author (NSA)

N70-24112# Oak Ridge National Lab., Tenn.
ELECTRON ATTACHMENT TO POLYATOMIC MOLECULES
E. L. Chaney and L. G. Christophorou Jan. 1970 131 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2613) Avail: CFSTI

Low energy (less than 10 eV) electron attachment to a number of polyatomic molecules was investigated using a high temperature electron swarm apparatus. Results are reported for nitrous oxide (N2O), azulene (C10H8), biphenyl (C6H5)2, aniline (C6H5NH3), acenaphthene (C12H9), and 1,4-naphthoquinone (C10H6O2). A simple model of electron attachment to polyatomic molecules is discussed and electron affinity calculations based on this model are presented for a number of molecules. Also, experimental results are presented and discussed which strongly support certain forms for the energy distribution functions for electron swarms in the carrier gases C2H4, N2, and Ar. Author (NSA)

N70-24114# Argonne National Lab., Ill.
MATDIAG: A PROGRAM FOR COMPUTING MULTILEVEL S-MATRIX RESONANCE PARAMETERS
Peter A. Moldauer, Richard N. Hwang and Burton S. Garbow Jul. 1969 28 p refs

(Contract W-31-109-eng-38)
(ANL-7590) Avail: CFSTI

The program MATDIAG computes cross section resonance parameters from Wigner's R-matrix. The input R-matrix parameters may be specified individually, or they may be generated statistically. The generated resonance parameters are analyzed statistically and may be used for the calculation of Doppler broadened multilevel cross sections in other programs. Author (NSA)

N70-24115# Rochester Univ., N.Y. Nuclear Structure Research Lab.
THE STATIC ELECTRIC QUADRUPOLE MOMENT OF THE FIRST EXCITED STATE OF Sm 148
H. S. Gertzman, D. Cline, H. E. Gove, P. M. S. Lesser, and J. J. Schwartz Feb. 1970 25 p refs Sponsored by NSF
(UR-NSRL-30) Avail: Issuing Activity

From measurements of Coulomb excitation of the 551 keV first excited state of Sm-148 using helium and oxygen ions, it has been possible to obtain a value for the static quadrupole moment of this state. The data yield two solutions corresponding to the choice of sign for the interference term due to virtual excitation of the second 2(+) excited state at 1454 keV. These results are: B(E2; O(+) yields 2(+) = 0.706 + or − 0.024 (e.b.) to the 2nd power and Q2(+) = +0.28 + or − 0.28 e.b assuming a negative interference term and B(E2) = 0.705 + or − 0.025 (e.b) to the 2nd power and Q2(+) = −0.24 + or −0.28 e.b assuming a positive interference term. A comparison with previously published results for this isotope and for neighboring nuclei suggests that the positive interference term is the more likely choice. Author

N70-24127# Argonne National Lab., Ill.
FAST NEUTRONS INCIDENT ON VANADIUM
Alan B. Smith, James F. Whalen, and Kenji Takeuchi May 1969 68 p refs
(Contract W-31-109-eng-38)
(ANL-7564) Avail: CFSTI

Total neutron cross sections and elastic and inelastic neutron scattering cross sections are experimentally studied. Total neutron cross sections are determined with good resolution from 0.1 to 1.45 MeV. Differential elastic and inelastic scattering angular distributions are measured at incident neutron energy intervals with incident neutron resolutions of approximately 20 keV. The inelastic excitation of states at 330 + or − 10 keV and 926 + or − 10 keV is observed. The experimental results are interpreted in terms of the optical model and statistical concepts, inclusive of resonance width fluctuations and correlations. The observed intermediate structure is discussed in the context of strongly overlapping resonances and distributions in resonance widths and spacings and in terms of an intermediate optical model. Comparison is made with previously reported experimental values and with the pertinent contents of the evaluated data file, ENDF-B. Numerical tabulations of the experimental results are provided. Author (NSA)

N70-24131# Rochester Univ., N.Y., Nuclear Structure Research Lab.
MEASUREMENT AND INTERPRETATION OF ELECTROMAGNETIC TRANSITIONS IN V 51
R. N. Horoshko, D. Cline, and P. M. S. Lesser Feb. 1970 49 p refs Sponsored by NSF
(UR-NSRL-32) Avail: Issuing Activity

Angular correlation measurements in the 180 deg geometry for the Ti-48(alpha, pgamma) V-51 reaction were used to determine the gamma-ray decay properties of states in V-51 at 0.32, 0.93, 1.61, 1.81, 2.41, 2.55, 2.68 and 2.70 MeV. Coulomb excitation measurements were used to deduce the B(M1) and B(E2) reduced transition probabilities for the decays of the 0.32, 0.93, 1.61, and 1.81 MeV states. For these states the M1 transitions are found to be retarded by factors ranging from about 400 to over 10,000, while the E2 transitions are enhanced by about an order of magnitude relative to the Weisskopf estimate. Shell model calculations were performed for V-51 considering all basic three protons states in the f-p shell and assuming a Ca-48 core. Remarkably good agreement is obtained between the calculated and measured transition rates, supporting the shell model predictions of a high configuration purity for the six levels of the basic multiplet. The spherical shell model provides an excellent description of the low lying states in V-51 and, contrary to Scholz and Malik, no evidence for deformation in this nucleus is found. Author

N70-24153# California Univ., Berkeley. Space Sciences Lab.
FORMULATION OF A HAMILTONIAN WITH RELATIVISTIC EFFECTS FOR HEAVY ATOMS Final Report
Samuel Silver and M. H. Mittleman (New York Univ.) 1969 23 p refs
(Contract DAHC04-67-C-0070; ARPA Order 1009; ARPA Order 462)
(AD-698508; AROD-7456-3) Avail: CFSTI CSCL 7/4

The work reported is concerned with problems of atomic scattering and structure. The principal effort was devoted to the problem of the construction of a configuration space Hamiltonian describing a heavy atom; this work is still in progress. Another general problem that has been investigated is the reaction mechanisms for electron-molecule (or molecular ion) recombination; a new and more fundamental understanding has been achieved here, opening the possibility for an a priori calculation of the important reaction of dissociative recombination. These and other efforts are described. Author (TAB)

N70-24188# Washington Univ., Seattle. Dept. of Physics.
AN IMPROVED METHOD OF CALCULATING FINITE RANGE CORRECTIONS IN TWO NUCLEON TRANSFER REACTIONS
N. S. Chant and N. F. Mangelson [1969] 31 p refs Supported by AEC
(RLO-1388-105) Avail: CFSTI

A method is developed for calculating finite range corrections in two nucleon transfer reactions. Certain approximations of currently used methods are eliminated and no new approximations are introduced. Sample distorted wave Born approximation calculations are presented. Changes due to the improvement in calculating the finite range corrections are found to be large. Author (NSA)

N70-24212# Rochester Univ., N.Y. Nuclear Structure Research Lab.
STATIC QUADRUPOLE MOMENTS OF THE FIRST EXCITED STATES OF Ni 58, 60, 62
P. M. S. Lesser, D. Cline, and J. D. Purvis Feb. 1970 33 p refs Sponsored by NSF
(UR-NSRL-29) Avail: Issuing Activity

Measurements of the relative thick-target yields of gamma rays de-exciting the 2(+) first excited states in Ni-58, 60, 62, following Coulomb excitation by carbon, oxygen and sulfur ions, were used to determine the relative static quadrupole moments of these states as well as the relative reduced transition probabilities. The measured yields were compared with calculations using a Coulomb excitation coupled channel computer code in order to extract the quadrupole moments and B(E2)'s. A previous experiment provided measurements of the absolute static quadrupole moment and B(E2) for Ni-60 and these are used to obtain absolute values for Ni-58 and Ni-62. The experimental results are compared with various shell model calculations as well as macroscopic model predictions. Qualitative agreement between theory and experiment is obtained. Author

N70-24217# Rochester Univ., N.Y. Nuclear Structure Research Lab.
THE STATIC ELECTRIC QUADRUPOLE MOMENTS OF THE FIRST EXCITED STATES OF Nd 144, 146, 148, 150
H. S. Gertzman, D. Cline, and H. E. Gove, and P. M. S. Lesser Feb. 1970 32 p refs
(UR-NSRL-31) Avail: Issuing Activity

From the relative yield of gamma rays de-exciting the 2(+) first excited states of Nd-144, 146, 148 and 150 following Coulomb excitation by helium, oxygen and sulfur ions, it is possible to measure the relative static quadrupole moments of these states. Radios of the gamma ray yields for different projectiles were compared with the calculations of a Coulomb excitation coupled channel computer code. A comparison with previously published data on the quadrupole moments for neighboring nuclei shows a smooth increase in the magnitude of the (negative) quadrupole moments of the first 2(+) states as one adds pairs of neutrons or neutron holes to the closed neutron shell at N=82. The static quadrupole momegts for Nd-148 and Nd-150 exceed the rotor value. Similar results were observed in previous reorientation measurements on rotational nuclei and is not understood at the present time. Author

N70-24233# ARO, Inc., Arnold Air Force Station, Tenn.
SPATIAL DISTRIBUTIONS FROM 285 TO 2500 K ARGON BEAMS SCATTERED FROM AN UNDEFINED COPPER SURFACE AT TEMPERATURES BETWEEN 36 AND 285 K
R. L. Caldwell, M. R. Busby, and R. F. Brown AEDC Dec. 1969 54 p refs
(Contract F40600-69-C-0001)
(AD-698325; AEDC-TR-69-142) Avail: CFSTI CSCL 7/4

An aerodynamic molecular beam and a phase-sensitive detection system were used to investigate the effects of the gas temperature, incidence angle, and surface temperature on the spatial distribution from 285 to 2500 degrees K argon beams reflected from an undefined copper surface. To determine the effects of the surface temperature on the spatial distribution, several experiments were run with a 0.54-ev incident beam at surface temperature of 285, 131, 77, and 36 degrees K. These data are the first known observations of lobular scattering patterns for low energy (i.e., 0.30- to 0.54-ev) beams scattered from contaminated surfaces at low temperatures. Author (TAB)

N70-24271# California Univ., Berkeley. Lawrence Radiation Lab.
SECOND-ORDER CORRECTIONS TO THE FINE-STRUCTURE OF HELIUM
Lars Hambro Aug. 1969 93 p refs
(Contract W-7405-eng-48)
(UCRL-19328) Avail: CFSTI

The fine-structure constant can be determined to high accuracy from precise measurements of the fine-structure of 2P-3 level in helium. One of the necessary calculations is to compute the contributions from the six Breit operators and the mass polarization operator in second-order perturbation theory. The eighteen spin-dependent perturbations from intermediate P-3 states are calculated by solving an inhomogeneous Schrodinger equation for the perturbation of the wave function by the variational method. The second-order contributions are then given by a single integral. These corrections are first calculated using standard Hylleraas expansions with up to 165 terms for the perturbed wave functions, resulting in contributions to the two fine-structure intervals of the order of 0.0001/cm, but only four of the results are sufficiently accurate. These variational calculations are improved by including additional terms, reflecting the singularities of the Breit operators, in the expansions. Author (NSA)

N70-24272# Columbia Univ., Irvington, N.Y. Nevis Labs.
TESTS OF THE ONE PHOTON EXCHANGE MODEL FOR HIGH ENERGY MUON-PROTON ELASTIC SCATTERING
Martin A. Kramer 1969 83 p refs
(Contract AT(30-1)-1932)
(NEVIS-178; CU-282; R-691) Avail: CFSTI

An experiment was performed to study muon-proton elastic scattering at momentum transfers of 0.15 to 0.85 (GeV/c) to the 2nd power. Cross sections were measured for negative muons at 6, 11, and 17 GeV and positive muons at 6 and 11 GeV. A four-foot long liquid hydrogen target was exposed to about 4.5 × 10 to the 9th power muons in each beam, resulting in a sample of about 2000 events for each momentum and sign. The data provide sensitive tests of the currently accepted one-photon exchange model of lepton-proton scattering first proposed by Rosenbluth. Previous tests of this theory (all made using electron-proton results) are extended to higher energies and smaller scattering angles. Since this is the first test of this theory as applied to muons, this is also a test of muon-e universality. The results confirm the predicted linearity of the Rosenbluth plot and the equality of the cross sections of positive and negative muons. Author (NSA)

N70-24279# California Univ., Berkeley. Lawrence Radiation Lab.
KAON(−) NEUTRON ELASTIC SCATTERING FROM KAON(−) d YIELDS KAON(−) d AND KAON(−) d YIELDS KAON(−) p n AT 1 GeV/c
Nathan Nay Shew Jew Oct. 1969 105 p refs
(Contract W-7405-eng-48)
(UCRL-19359) Avail: CFSTI

Experimental angular distributions for negative kaon deuteron yields negative kaon and negative kaon deuteron yields negative kaon proton neutron at incident negative kaon momenta of 810, 910, 1010, and 1110 MeV/c are presented. These distributions are analyzed simultaneously in terms of free nucleon scattering parameters, using Glauber's impact parameter formalism as a starting point. This formalism was modified to make it applicable to the data, which contained a proton momentum cut made during scanning. In addition, two other modifications to this formalism are incorporated into the analysis. One of these arose from the difference in flux factors between negative kaon deuteron and negative kaon-nucleon scattering, the other from the smearing of the nucleon cross-sections due to Fermi momentum. Finally, this formalism was extended to include spin dependence. The method of analysis required both the negative kaon proton and negative kaon neutron elastic scattering amplitudes. The negative kaon proton amplitudes were input from two models based on experiment. Author (NSA)

N70-24374# Brookhaven National Lab., Upton, N.Y.
PARTICLE IDENTIFICATION AT RELATIVISTIC ENERGIES BY THE USE OF SECONDARY EMITTERS WITH NEGATIVE ELECTRON AFFINITY
J. Llacer [1969] 16 p refs Presented at 12th Scintillation and Semiconductor Counter Symp., Washington, D.C. Sponsored by AEC
(BNL-14183; Conf-700301-1) Avail: CFSTI

The usefulness of negative electron affinity secondary emitters as detectors of particles in the high relativistic region is studied theoretically in detail. It is found that GaP(Cs) has poor secondary escape statistics, resulting in the inability to distinguish between 200 BeV/c protons and pions in single particle experiments. GaAs (Cs + (O2 + C8)) has good escape statistics, but its active depth may be too large, and density effects are expected to set in. A GaP sub (1-x) GaAs sub (x) heterojunction which could solve both problems is discussed. In any case, it is found that nonlinear filtering of the near Landau distributed signals from secondary emitters is required in order to obtain useful particle discrimination. One feasible scheme is proposed which should allow separating 200 BeV/c protons and pions, for example, with 90% efficiency or better at near 100% confidence. Author (NSA)

N70-24504# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THE CORRECTION OF THE SCINTILLATION gamma SPECTRA FOR THE INSTABILITY OF THE SPECTROMETER
J. Slunecko and P. Kovanic Jul. 1969 51 p refs
(UJV-2213-Ch) Avail: CFSTI

The computer program COGARASS, written in Gier Algol 3 for the Gier computer is presented. This program corrects gamma scintillation spectra for quantitative analysis of mixtures of radioisotopes. No standard sample is used. Instead, the correction procedure utilizes photopeaks in the spectra as reference peaks. NSA

N70-24506# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.

OPTIMIZATION OF HELIX ACCELERATORS

H. Schopper Aug. 1969 32 p

(KFK-1029) Avail: CFSTI

A systematic study of the optimization of a helix accelerator enables a better understanding of discrepancies in the literature and provides a new way of choosing the helix parameters. The losses in the helix are calculated in a more consistent manner from the sheath model. A high shunt impedance over a large range of particle momenta with comparatively few frequency jumps can be achieved. A helix accelerator seems to be useful for nucleon energies up to 200 MeV. A normal as well as superconducting helix is considered. The results are applicable to the acceleration of protons and heavy ions. Author (NSA)

N70-24513# Kernforschungszentrum, Karlsruhe (West Germany). Literaturabteilung.

FOCUSING OF A CHARGED ELECTRON RING IN THE COLLECTIVE ION LINEAR ACCELERATOR [FOKUSSIERUNG EINES GELADENEN ELEKTRONENRINGES IM KILLETIVEN IONENLINEARBESCHLEUNIGER]

A. G. Bonch-Osmolovskii et al [1969] 10 p refs Transl. into GERMAN from Russian Rept. JINR-P9-4135 In GERMAN

(KFK-tr-297; JINR-P9-4135; CERN-Trans-69-8) Avail: CFSTI

Problems of charged electron ring focusing in the collective ion linear accelerator are discussed. Three types of focusing are considered: focusing of the azimuthal component of the magnetic field, focusing by counter waves and focusing by the image forces. The conditions of the stability of the electron oscillations in the ring are obtained and the possibilities of applying the above-mentioned types of focusing are determined. Author (NSA)

N70-24527# Lund Univ. (Sweden). Dept. of Physics.

PION EFFECTS IN I 127(gamma, xn) REACTIONS OF HIGH MULTIPLICITY

G. G. Jonsson and K. Lindgren Oct. 1969 14 p refs

(NP-18064) Avail: CFSTI

The yields of the reactions (gamma,6n), (gamma,7n), (gamma,8n), and (gamma,9n) in I-127 were measured by activation analysis from their thresholds up to 900 MeV. The experimental results above the pion threshold were compared with theoretical calculations based upon a cascade-evaporation model. Good agreement was found. Author (NSA)

N70-24538# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.

ELASTIC PION N SCATTERING AND CHARGE EXCHANGE ACCOUNTING FOR THE CONTRIBUTIONS OF THE BRANCHINGS [UPRUGOE PION N RHSSEYANIE I PEREZARYADKA S UCHETOM VKLADA VETVELNII]

V. Yu. Glebov, A. B. Kaidalov, S. T. Sukhorukov, and K. A. Ter-Martirosyan 1969 38 p refs In RUSSIAN

(ITEF-699) Avail: CFSTI

The analyses of the experimental data on pion + or - p scattering and pion(-)p-charge exchange are carried out in the framework of the complex angular momentum method. The branch points in j-plane are taken into account. Their contribution to the amplitudes of the processes are parametrized in a simple form which corresponds to the optical model of the successive rescatterings. Good agreement with the experiment is achieved in the region of the small momentum transfer. Author (NSA)

N70-24539# Stanford Linear Accelerator Center, Calif.

PHOTOPRODUCTION OF PI(O) MESONS OF NUCLEI AT HIGH ENERGIES

V. A. Tsarev May 1969 27 p refs Transl. into ENGLISH from Russian Preprint LEBEDEV-69-6

(SLAC-TRANS-96) Avail: CFSTI

It is shown that measurements of the cross section for the photoproduction of pion(0) mesons on nuclei can be used (1) to investigate the Regge trajectory of the omega meson; (2) to determine the sign of the amplitude for the pion(0) → 2gamma decay, and (3) to verify the predictions of the vector dominance model. Author (NSA)

N70-24540# Bonn Univ. (West Germany). Inst. fuer Strahlen und Kernphysik.

NUCLEAR SPECTROSCOPY AND NUCLEAR REACTION PHYSICS Annual Report, 1967 - 1968

Oct. 1969 84 p refs In GERMAN

(BMwF-FBK-69-36) Avail: CFSTI

This annual report of the Institute for Nuclear and Radiation Physics at the University of Bonn gives information about the scientific work carried out during the period 1967 - 1968 in the field of nuclear spectroscopy and nuclear reaction physics. Details are also given about the equipment under construction (isochronous cyclotron, beam analyzing system, isotope separator, split pole spectrograph, and data handling equipment). Publications issued during the period are listed. Author (NSA)

N70-24544# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.

CROSS SECTIONS OF THE FORMATION OF gamma QUANTA IN THE REACTION (n,n' gamma) IN FLUORINE, COBALT, ANTIMONY, AND TANTALUM NUCLEI [SECHENIYA OBRAZOVANIYA GAMMA-KVANTOV V REAKTSII (n,n'GAMMA) NA YADRAKH FTORA, KOBAL'TA, SUR'MY I TANTALA]

D. L. Broder, A. F. Gamalii, A. I. Lashuk, B. V. Nesterov, and I. P. Sadokhin 1969 24 p refs In RUSSIAN

(FEI-155) Avail: CFSTI

A semiconductor Ge(Li) detector was used to measure the gamma spectra arising from inelastic scattering of neutrons on F-19, Co-59, Sb, and Ta-181 nuclei. The following energies were found for the gamma-quanta from the respective nuclei: For F-19, 110 + or - 1 and 200 + or - 1 keV; for Co-59, 1095 + or - 2, 1190 + or - 2, 1280 + or - 2, and 1400 + or - 2 keV; for Sb, 153 + or - 1 keV; and for Ta-181, 137 + or - 2, 153 + or - 2, 163 + or - 2, 302 + or - 2, and 482 + or - 1 keV. The cross sections of formation of these gamma-quanta in the process of nonelastic neutron scattering is determined. Results are compared with those of other authors and recommended curves are shown for the gamma-quanta formation cross sections. Author (NSA)

N70-24548# Leiden Univ. (Netherlands). Kamerlingh Onnes Lab.

DIRECTIONAL ANISOTROPY OF NEUTRON-CAPTURE GAMMA RAYS FROM ALIGNED NUCLEI

H. Postma [1969] 15 p refs Presented at the Meeting on Nucl. Phys. Div., Am. Phys. Soc., Boulder, Colo., 30 Oct. - 1 Nov. 1969

(CONF-691019-1) Avail: CFSTI

Methods for the determination of nuclear spins in neutron-capture gamma spectroscopy are discussed. A technique using the directional anisotropy of neutron-capture gamma rays from aligned nuclei is described in detail. Some results for neutron capture by aligned Sm-149 and Co-59 at 0.05 eV are presented. NSA

N70-24583# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ON THE PION FORM FACTOR ON THE BETHE-SALPETER MODEL

J. Fleischer and F. Gutbrod Oct. 1969 17 p refs

(DESY-69/43) Avail: CFSTI

A Bethe - Salpeter model is presented, in which phenomenological potentials are used to reproduce the rho peak in the pion pion scattering amplitude. Then the off shell amplitude is taken to calculate the pion electromagnetic form factor. The

Bethe – Salpeter equation is used in the ladder approximation and solved by iteration and application of the Pade approximation method. Reasonable agreement with the vector dominance model is achieved. Author (NSA)

N70-24585# South Carolina Univ., Columbia. Dept. of Physics.
FEASIBILITY STUDY OF ANTINEUTRINO ABSORPTION CROSS SECTION MEASUREMENTS Annual Report, May 1968 – May 1969
F. T. Avignone, III and C. W. Darden, III Apr. 1969 19 p refs
(Contract ST(38-1)-474)
(SRO-474-1) Avail: CFSTI

The neutron and gamma ray background was measured at several locations near one of the Savannah River production reactors. A site was chosen at which the calculated antineutrino flux from the reactor is high enough to conduct inverse beta decay experiments while neutron and gamma-ray backgrounds are relatively low. Studies of the gamma-ray singles and coincidence gamma-ray backgrounds inside of various configurations of lead, boron loaded polyethylene and cadmium shielding were made. An optimum shielding configuration was determined. CsI(Na) scintillators were investigated as possible detectors in low background gamma-ray coincidence measurements and found to be inferior to NaI(Tl) scintillators for this type of experiment. The effectiveness of a NaI(Tl) live anticoincidence shield in reducing the background coincidence events was investigated. An event consists of a coincidence resulting from the deposit of approximately 0.511 MeV, in each of two NaI(TO) detectors placed inside. Author (NSA)

N70-24596# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
SYSTEMATIZATION OF ELEMENTARY PARTICLES AND CONSIDERATIONS OF THE FOUNDATIONS OF THE FUTURE THEORY
I. L. Gerlovin 1969 52 p refs In RUSSIAN
(ITF-69-53) Avail: CFSTI

A method of complete systematization of elementary particles is described. Within this systematization there were obtained formulas for the theoretical calculation of parameters of all the particles, such as masses, charges, spins, magnetic moments, interaction constants and other parameters. The dimensionless spectra of particle parameters are derived from one fundamental quantum number. Values of this number are determined as parameters resulting in solutions of one equation. Thus, neither arbitrary value nor value taken from experiment are used in the calculation formulas. Only two world constants h and C were used in calculations but only as scale units. The coincidence of calculated values with the observed ones is complete. However, the theory predicts the existence of many undiscovered particles within very high-energy region as well as within relatively low-energy region. Dissert. Abstr.

N70-24598# Argonne National Lab., Ill.
LORENTZ POLES AND VENEZIANO REPRESENTATION
G. Domokos and S. Koevesi-Domokos Jul. 1969 9 p refs
(Contract AT(30-1)-4076)
(NYO-4076-3) Avail: CFSTI

The group theoretical structure of scattering amplitudes exhibiting duality is investigated. Veneziano-type representations are obtained if one assumes that the amplitude is dominated by single Lorentz poles in overlapping channels. It is found that duality and irreducibility in overlapping channels are incompatible with each other. Author (NSA)

N70-24624# Tubingen Univ. (West Germany). Inst. fuer Theoretische Physik.
EXACT UPPER AND LOWER BOUNDS FOR THE BINDING ENERGY OF THE TRITON WITH SOFT-CORE POTENTIAL [EXAKTE OBERE UND UNTERE SCHRANKEN FUER DIE TRITONBINDUNGSENERGIE MIT SOFT-CORE POTENTIAL]
H. Ziegelmann Oct. 1969 85 p refs In GERMAN
(BMwF-FBK-69-33) Avail: CFSTI

The accuracy of Hackenbroich's approximation in the Jastrow factor, the flexibility of the trial function and the importance of nonsymmetric functions are tested in the case of the triton and generalized to the alpha-particle. A procedure was developed to calculate separately the contributions of different regions configuration space to the gap between upper and lower bounds. So one obtains information which clearly shows, where the trial function should be improved and which allows a very precise estimation with respect to the eigenvalue. Author (NSA)

N70-24625# Technische Hochschule Munchen (West Germany). Teilinstitut Maier-Leibnitz Im Physik Dept.
NUCLEAR RESEARCH Annual Report, 1968
Nov. 1969 246 p refs In GERMAN
(BMwF-FBK-69-37) Avail: CFSTI

From nuclear physics the following results are given: Measurements and calculations of (n,el–l), (n,gamma) and (n,ngamma) spectra, of cross sections for (n,2n) reactions, of coherent scattering length and of free cross sections for slow neutrons and of half-lives of excited free cross sections for slow levels of Ag and U. It is reported about the influence of radiation damage after low temperature irradiation on electrical, magnetic and lattice properties of metals as well as about scattering experiments with slow neutrons and x rays on liquids and poly-crystals. New apparative developments have been a time-of-flight neutron spectrometer with high resolution, neutron guide tubes for polarized and very slow neutrons, a magnet spectrograph and a time-of-flight system for the tandem accelerator. Author (NSA)

N70-24626# Princeton Univ., N.J. Plasma Physics Lab.
PARTICLE TRAJECTORIES IN STATIONARY TRAPPED-PARTICLE MODES
C. Jablon May 1969 17 p refs
(Contract AT(30-1)-1238)
(MATT-679) Avail: CFSTI

The influence of stationary electrostatic potential on the trajectories of particles trapped between magnetic mirrors in a toroidal geometry is studied. The particle movement in an axisymmetric situation is first discussed. An irregular electrostatic potential was next introduced and the movement was studied in this case. In addition to the classical "superbanana excursion" it was shown that under certain circumstances a total de-trapping of the particle occurs, which can prevent this type of excursion. The case of a Tokamak-like geometry (but with strong rotational transform, like a stabilized pinch or Levitron) and the influence of the perturbation on the location of the turning points were studied. Some computed results are shown and an analytic approximate expression is derived for this case. Author (NSA)

N70-24632# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
CONCERNING THE NUMBER OF FISSION CHANNELS AND THE INTERPRETATION OF THE ENERGY DEPENDENCE PROBABILITY OF THE (d,PF) REACTION
P. Yu. Vorotnikov 1969 16 p refs In RUSSIAN
(IAE-1819) Avail: CFSTI

Attention is directed toward errors in existing methods for determining the number of fission channels. It is shown in particular that the steps in the energy dependence of the fission probability of Pu-239 by deuterons and similar nuclei can be explained by the resonance maxima of the fission width related to the quasistationary states of the fissioning nuclei. The widths of the states are several hundred keV and the distance between them is about 0.7 MeV. These states, also evident in cross section of the (d,p) reaction, are observed up to excitation energies exceeding the fission barrier by 1.5 MeV, and therefore cannot be explained as features of the form of the barrier. Certain properties of quasistationary states are discussed, and an assumption is made that they are related to the stable octupole deformation of the nucleus prior to fission. Author (NSA)

N70-24643 Washington Univ., Seattle.
ANALYTIC MULTIGROUP THEORY
Maurice Ralph Egan (Ph.D. Thesis) 1969 223 p
Avail: Univ. Microfilms: HC$10.15/Microfilm Order No. 69-20221

A new analytical method is developed for solving problems in neutron multigroup theory. The method is based on principles of linear operator theory applied to a vector space, one of whose coordinates is discrete. It produces solutions, analytic in all continuous coordinates and exact to within the starting approximation, to multigroup problems. A numerical study of the importance of these effects in a one-region, homogeneous system in plane geometry is made using the rigorous P-1 theory and three simpler approximations to it. Results are obtained both for time-dependent and time-independent forms of the multigroup operator, and their subsequent comparison clearly demonstrates the limitations of using quasi-time-independent calculations to analyze time-dependent systems not near critical. The theory is also used to derive analytic solutions to the problem in which the transport mean-free-path is energy-dependent. Numerical comparison of these results with discrete-ordinate multigroup calculations confirms the accuracy and improvement of the analytic solutions for two model problems. Dissert. Abstr.

N70-24714# France. Ministere de l'Air, Paris.
SECOND ORDER NONLINEAR SPINOR THEORY FOR ELEMENTARY PARTICLES [SUR UNE THEORIE SPINORIELLE NON LINEAIRE DU SECOND ORDRE DES PARTICULES ELEMENTAIRES]
Emile Bassila 1969 87 p refs In FRENCH
(NT-167) Avail: CFSTI

The second order nonlinear spinor theory was reduced to a linear equation in regard to functional field. Experimental and given results are mathematically formulated along with an examination of the detected elementary particles. Quantum numbers are connected to the conservation and symmetry of invariant groups. The nonlinear theories of Heisenberg and others are assessed in relation to the proposed theory. Transl. by J.M.C.

N70-24771*# Massachusetts Inst. of Tech., Cambridge. Particle Optics Lab.
CHARGED PARTICLE SOURCES FOR IMPLANTATION AND SURFACE REACTIONS Final Report
F. G. Ruedenauer and C. K. Crawford Dec. 1969 122 p refs
(Contract NAS12-679)
(NASA-CR-86333; TR-4) Avail: CFSTI CSCL 20H

A high temperature ion source of the Unoplasmatron type is described with measured brightness values at 2kV of beta > 0.1 A/sq cm sr for ions such as Ar, Pb, Ga. Beam currents for these elements were 6 micro A, 3 micro A, 1 micro A respectively. Total power input for the Ga run (operating temperature 1400 K) was < 110 watts. Source dimensions are 1in. dia x 3.5 in. long. The design of a demagnifying system is given which, if used in connection with the new ion source, is capable of bombarding a 1 micrometer diameter spot with current densities > 50 micro A/sq cm. The main features of this system are a new type of a stigmatic focusing magnetic mass analyzer and a three lens electrostatic focusing stage with a special minimum aberration postacceleration lens. Bombarding voltages can be as high as 40kV. Author

N70-24772 Princeton Univ., N.J.
A MEASUREMENT OF THE K(0) SUB 1 - K(0) SUB 2 MASS DIFFERENCE
Robert Kenneth Carnegie (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-9674

A new measurement of the magnitude of this mass difference was completed using the gap method. The virtue of this method, which consists of monitoring the coherently regenerated K(0) sub 1 intensity behind two slabs of material separated by a variable air gap, is its relative freedom from possible systematic errors. The result for the mass difference does not depend on precise knowledge of either the nuclear regeneration amplitude or the details of the detection efficiency of the apparatus. Dissert. Abstr.

N70-24773# Central Electricity Generating Board, Berkeley (England). Research and Development Dept.
A NEW VERSION OF THE PRIZE PROGRAM FOR COLLISION PROBABILITY CALCULATIONS IN R-Z GEOMETRY
P. W. Johnson and D. L. Nunn Oct. 1969 71 p
(RD/B/N-1410; RPLC/P-256) Avail: CFSTI

The original U.K.A.E.A. program PRIZE was converted for use on the 360 computer. A number of new facilities were added, most important of which was a new axial boundary treatment. In its present form the program is coupled with PIP for the solution of the collision probability equations; it is intended soon to include it within WIMSD. A complete account is given of the new version of PRIZE, together with some results both on test cells, designed to illustrate the effects of different facilities, and also on an experimental cluster. Author (NSA)

N70-24825# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE UPPER AND LOWER LIMITS OF THE ELEMENTARY PARTICLE RADIUS
Dao Vong Dyc and Nguyen Van Hieu 1969 8 p refs In RUSSIAN
(JINR-P2-4798) Avail: CFSTI

Expressions for the upper and lower limits of elementary particle radius containing the values of the form factor modulus on the cut were obtained. With this aim a corresponding extremal problem of the analytic function theory was solved. If the form factor modulus of pi-meson is expressed by the resonance formula of the Breit–Wigner type which corresponds to rho-meson then it follows from the results obtained that pi-meson radius is equal to 0.62 + or − 0.12 ferm. Author (NSA)

N70-24843# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
SEARCH FOR LONG-LIVED SPONTANEOUSLY FISSIONING EMITTER IN THE SAMPLES WITH Bi, Pb, Hg, W
E. Cieslak 1969 12 p refs In RUSSIAN
(JINR-P15-4738) Avail: CFSTI

Tracks of nuclear fission fragments were observed in the glasses with Bi, Pb, Hg and W. For a few samples of lead glasses the measured spontaneous fission half-life was found to be 3 10 to the 20th power years. Observed tracks cannot be explained either by spontaneous fission or by cosmic-ray induced fission of a uranium impurity. The presented data support the hypothesis of the existence of long-lived spontaneously fissioning nuclei. Author (NSA)

N70-24844# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
OPTICAL MODEL WITH THE SOURCE
Yu. I. Fenin 1969 13 p refs In RUSSIAN
(JINR-P4-4511) Avail: CFSTI

In the generalized nuclear reaction theory with an account of particle rearrangement, the sources appear naturally in the Schrodinger equation. Introduction of the source into an ordinary optical model describes a more fine structure in the dependence of the neutron strength functions on the atomic weight. Author (NSA)

N70-24845# Paris Univ., Orsay (France). Lab. of the Linear Accelerator.
RESEARCH AND DEVELOPMENT PROJECTS AT THE ORSAY LINAC LABORATORY], MAY 1968 – May 1969
Oct. 1969 105 p refs In FRENCH
(LAL-1224) Avail: CFSTI

Research and development projects at the Orsay Linac Laboratory from May 1968 to May 1969 are described. Operation of the linear accelerator and the ACO electron-positron storage ring are described, and progress on the multi-GeV Coppelia storage ring project is reported. Developments at the giant heavy-liquid bubble chamber Gargamelle are outlined including film analysis techniques. General instrumentation development is discussed, and nuclear and particle physics research summarized. Publications issued during the period are listed. NSA

N70-24855# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

PHYSICAL AND TECHNICAL LIMITATIONS OF STORAGE RING LUMINOSITY

R. D. Kohaupt, H. Nesemann, and A. Piwinski Oct. 1969 25 p refs

(DESY-69/44) Avail: CFSTI

The energy dependence of storage ring luminosity is investigated for variable crossing angle. The limiting effects are reviewed, described in a simplified model and compared with exact calculations, using DESY parameters. Author (NSA)

N70-24856# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

RENORMALIZABLE MODELS WITH SIMPLE SYMMETRY BREAKING. PART 1: SYMMETRY BREAKING BY A SOURCE TERM

K. Symanzik Sep. 1969 47 p refs

(DESY-69/36) Avail: CFSTI

If to a Lagrangian density with invariance under a continuous group of linear transformations of the fields a term linear or bilinear in the fields is added, the symmetry is in general reduced and the currents associated with the original symmetry are only partially conserved. If the theory without the added term is renormalizable, the theory with that term also is, and the needed renormalization conditions are the essential content of the appropriate Ward-Takahashi-Kazes-Rivers identities. The case of symmetry breaking by a term linear in Bose fields (source term) is analyzed completely, in particular with respect to the nonsymmetric limit of vanishing source term, a particular Goldstone mode, and with respect to properties of the ground state energy density as a function of the strength of the source term. Induced and spontaneous breaking of a discrete symmetry are also treated. Author (NSA)

N70-24858# Virginia Polytechnic Inst., Blacksburg.

NEUTRON TRANSPORT THEORY CONFERENCE, 20 - 24 JANUARY 1969

Aug. 1969 675 p refs Sponsored by AEC

(ORO-3858-1; CONF-690108) Avail: CFSTI

The complete text of 26 conference papers on various aspects of neutron transport theory are presented. E.C.

N70-24889# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ON THE EFFECT OF ULTRASOUND ON THE FORMATION OF IONIZING PARTICLE TRACKS IN LIQUID-HYDROGEN BUBBLE CHAMBER

V. A. Akulichev, L. R. Gavrilov, V. G. Grzbinnik, V. A. Zhukov, G. Libman et al 1969 15 p refs In RUSSIAN

(JINR-P13-4702) Avail: CFSTI

The effect of ultrasound on the formation of ionizing particle tracks in liquid hydrogen bubble chamber is investigated experimentally. Design features and characteristic regimes of acoustic systems leading to a considerable effect of ultrasound on the increase of bubbles, which form tracks, are described. Author (NSA)

N70-24896# California Univ., Los Angeles. Dept. of Physics.

RESEARCH PROGRAM OF THE NUCLEAR CONSORTIUM AT THE UCLA CYCLOTRON LABORATORY

J. Reginald Richardson, Byron T. Wright, William H. Louisell (Univ. of Southern California), and Robert M. Eisberg (California Univ., Santa Barbara) Jul. 1969 89 p refs

(Contracts AT(11-1)-GEN-10; AT(04-3)-136; AT(11-1)-34) (UCLA-10-P-18-13) Avail: CFSTI

Cyclotron and laboratory operations and basic research efforts are reviewed. Consortium work was centered on building components for an external axial ion source, beam optics system development, and modification of a magnetic spectrometer. E.C.

N70-24903# Oregon State Univ., Corvallis. Nuclear Chemistry Group.

NUCLEAR CHEMISTRY Progress Report, 15 Jun. 1968 - 15 Mar. 1969

Walter D. Loveland Mar. 1969 34 p refs

(Contract AT(45-1)-2080) (RLO-2060-1) Avail: CFSTI

Research carried out at Oregon State University in the period June 15, 1968 to March 15, 1969, is described. Work was done in nuclear fission data compilation, fission studies, cosmochemistry neutron beam extraction from the TRIGA reactor, and the theory of centrifugal stretching in nuclei. NSA

N70-24915# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

EXCITED STATES OF NUCLEI IN NEGATIVE MUON CAPTURE BY CARBON AND OXYGEN

Yu. G. Budyashov, V. G. Zinov, A. D. Konin, S. V. Medved, A. I. Mukhin et al 1969 20 p refs In RUSSIAN; ENGLISH summary

(JINR-P15-4745) Avail: CFSTI

The probability of the excited nuclear level production in negative muon capture by carbon and oxygen nuclei was investigated. The energy of the gamma ray and transition time dependence after the muon stop was measured with NaI(Tl) detector. The partial capture rate of the 1( ) and 2( ) state of B*-12 and the total capture rate of all the B*-12 excited bound states in the negative muon capture by C-12 for the reaction C-12 + negative muon yields B*-12 + neutrino have been determined. The yield of 2.13 MeV gamma rays which follow the reaction C-12 + negative muon yields B*-11 + neutron + neutrino was measured. In the experiment on negative muon capture in O-16 for the reaction O-16 + negative muon yields N*-15 + neutron + neutrino the sum capture rate to the N*-15 even parity excited bound states and the capture rate to the 3/2( ) state of N*-15 were determined. The total capture rate to all the excited bound states of N*-15 was determined also. Some of the results disagree essentially with theoretical predictions. Author (NSA)

N70-24916# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CROSS SECTIONS OF LIGHT NUCLEI SPLIT BY HIGH-ENERGY PROTONS

O. B. Abdinov and V. S. Barashenkov 1969 9 p refs In RUSSIAN

(JINR-P2-4788) Avail: CFSTI

Splitting of C-12 and O-16, with the production of isotopes which are of interest for some applied problems of nuclear physics, has been calculated by the intranuclear cascade model. The decay of the highly excited residue nucleus, produced after the cascade stage of the process, was considered using the Fermi statistical theory. The results agree with the available experimental data. Author (NSA)

N70-24917# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INTERACTION CROSS SECTIONS OF HIGH ENERGY PARTICLES WITH THE ATOMIC NUCLEI

S. M. Eliseev 1969 10 p refs In RUSSIAN

(JINR-P2-4509) Avail: AEC Depository Libraries

To calculate nuclear cross sections of sigma sub t, sigma

sub el. sigma sub in the energy region from several hundreds of MeV and more the Glauber theory can be used. For heavy nuclei the theory gives the results not more accurate than for a usual optical model. Author (NSA)

N70-24324# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

INFLUENCE OF ANISOTROPIC SCATTERING ON THE NEUTRON DIFFUSION COEFFICIENT IN HETEROGENEOUS SYSTEMS WITH PERIODIC STRUCTURE [VPIV ANIZOTROPNE SIPANJA NEVTRONOV NA KOMPONENTE DIFUZIJSKEGA TENZORJA V HETEROGENIH SISTEMIH S PERIODICNO STRUKTURO]

G. Pregl Dec. 1968 46 p refs In SLAVIC
(NIJS-P-235) Avail: CFSTI

The time dependent monokinetic transport equation with linearly anisotropic scattering law is partially solved for a periodic lattice. The method applied is based on three dimension Fourier transform of the transport equation in which the cross sections are expressed by two dimensional Fourier series. Explicit expressions are derived for the anisotropic diffusion coefficient of a square lattice with cylindrical empty channels. The main difference compared to previous theoretical results is in the expression for the diffusion coefficient parallel to channels. The quadrupole term is important in this case. Measurements are reported together with all known experiments on systems with empty channels. Special attention is devoted to the functional dependence between the decay constant and the size of the system. The expression for the parallel component which is derived is in good agreement with experimentally determined values. Hence, the discrepancy between the experimental data and the theoretical predictions can be regarded as resolved. Author (NSA)

N70-24925# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

VECTOR MESON DOMINANCE AND PHOTOPRODUCTION OF PSEUDOSCALAR MESONS

D. Schildknecht Oct. 1969 40 p refs Presented at the Intern. Seminar on Vector Mesons and Electromagnetic Interactions, Dubna, USSR
(DESY-69/41; CONF-690930-1) Avail: CFSTI

A review of the vector dominance model for photoproduction of pseudoscalar mesons is presented. This review covers the vector dominance model of photoproduction and electroproduction including the field-current identity, the transverse amplitude, the mass-extrapolation assumption, and the s-channel helicity frame; and the application of the vector dominance model to photoproduction of pseudoscalar mesons. NSA

N70-24926# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

NEUTRON FORM FACTORS FROM QUASI-ELASTIC E-D SCATTERING

W. Bartel, F. W. Buesser, W.-R. Dix, R. Felst, D. Harms et al Sep. 1969 11 p refs
(DESY-69/34) Avail: CFSTI

By recording electron-neutron and electron-proton coincidences, the ratio of the electron scattering cross sections on quasi-free neutrons and protons was determined. An estimate of the binding effects, based on a Chew – Low-extrapolation, was made. Values for the neutron form factors were derived. Author (NSA)

N70-24980# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

ON THE PION REGGE TRAJECTORY

A. Capella Feb. 1970 18 p refs
(TH-70/8) Avail: CFSTI

Assumed is that the pion belongs to a non conspiring parent Regge trajectory in order to find the minimal $t = 0$ behavior of its Regge residues compatible with analyticity and factorization. It turns out that the pion trajectory decouples from any pair of identical particles at $t = 0$. It is shown that this decoupling can be deduced from simple physical considerations based on an analogy with an elementary pion exchange provided one can put pion Regge trajectory = 0 at $t = 0$. Author

N70-25015# Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares.

FORTRAN PROGRAM: LFEN-FR 5, DIFNE. CALCULATION OF NEUTRON FLUX ASSOCIATED WITH SUBCRITICALITY [PROGRAMA FORTRAN LFEN-FR 5, DIFNE. CALCULO DE FLUXOS NEUTRONICOS EM CONJUNTOS SUBCRITICOS]

Jose F. Salgado and H. Machado Jorge 1969 34 p refs In PORTUGUESE
(LFEN-NI.43(alpha)) Avail: CFSTI

DIFNE is described as a program in FORTRAN 2 language for the calculation of neutron flux in subcritical cylindrical geometries, by means of a diffusion theory for two groups. The applications and the fundamentals of the diffusion theory are presented. Included are: a description of the program for fast and thermal neutrons; the symbols, input, output, and instructions for the use of the program. Transl. by F.O.S.

N70-25039 Polytechnic Inst. of Brooklyn, N.Y.

ON THE NON-COHERENT MINIMUM UNCERTAINTY STATES

Pierre P. Bertrand (Ph.D. Thesis) 1969 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-20316

The photon statistics of a field in a minimum uncertainty state are investigated by means of a photon counting experiment of the Hanbury Brown and Twiss type, and it is shown that these states could lead to the observation of an anticorrelation effect. The dynamics of the minimum uncertainty states in the presence of interaction are discussed. It is shown that the free radiation field, initially in a minimum uncertainty state, does not remain in such a state. The most general form of the Hamiltonian under which these states remain minimum uncertainty, at all times, is given; it is shown, however, that under these conditions the operator whose eigenfunctions are the minimum uncertainty wave packets is not necessarily an analytic signal. Dissert. Abstr.

N70-25044 California Univ., Berkeley.

CONSTRAINTS ON STRONG INTERACTION AMPLITUDES IMPOSED BY PCAC AND CURRENT ALGEBRA

Lay Nam Chang 1967 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-10299

Using the hypothesis of the partially conserved axial-vector currents, and specific assumptions on the equal-time commutation relations, a calculation of the pion production amplitude near threshold of the pion N system was attempted. The resulting matrix elements are contrasted with those obtained previously by other means, and a comparison with existing data on total cross section and angular distribution is made. Agreement is favorable for the energy range considered. Unlike previous studies of the production amplitudes where direct pion-pion interactions are thought to play a substantial role, the present calculation ignores all possibilities of strong pion-pion effects, and incorporates only those pion-pion scattering effects required by the consistency of the current algebra approach. The evaluation of these contributions require some assumptions on the equal-time commutators of pseudo-scalar and scalar densities. Finally, suggestions are made on the extension of the present approach based on resonance models. Dissert. Abstr.

N70-25105# Illinois Univ., Urbana. Dept. of Physics.

NEGATIVE Xi HYPERON PRODUCTION IN 5.5 GeV/C NEGATIVE KAON PROTON INTERACTIONS

E. L. Goldwasser and P. F. Schultz 29 Oct. 1969 24 p refs Supported by AEC
(COO-1195-172) Avail: CFSTI

Final states with a Xi hyperon(−) were studied in 5.5-GeV/c

K(−) p interactions. Center-of-mass production angular distributions for the Xi hyperon(−) have a peak in the beam direction while those for the K(+) or K(0) meson peak in the opposite direction. Approximately half of the observed events involve the Xi hyperon(1530) or K(890) resonances. The four- and five-body final states show production of the Xi hyperon(1930) in the Xi hyperon(−) pion(+,0) mass spectrum and a narrow peak at 2295 MeV in the Xi hyperon(−) pion(+) pion(−) mass spectrum. The mass of the Xi hyperon(−) is 1321.9 + or − 0.5 MeV as determined from 195 Xi hyperon(−) decays with a visible Lambda hyperon decay. Author (NSA)

N70-25143# Scientific Translation Service, Ann Arbor, Mich.
ENERGY DEPENDENCE OF THE INTERACTION CROSS SECTIONS OF PI-MESONS WITH ATOMIC NUCLEI AT ENERGIES HIGHER THAN 50 MeV
V. S. Barashenkov et al [1969] 8 p refs Transl. into ENGLISH from Russian report JINR-P2-4520 Sponsored by AEC Prepared for ORNL
(ORNL-tr-2236; JINR-P2-4520) Avail: CFSTI

The curves of the energy dependence of the integrated cross sections for the interaction of Pi-mesons with He, Be, C, Al, Ti, Fe, Cu, Gd, Pb, U are given. Author (NSA)

N70-25191 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1969 CERN SCHOOL OF PHYSICS
19 Nov. 1969 214 p refs Held at Leysin, Switzerland, 31 Aug. – 13 Sep. 1969
(CERN-69-29) Copyright. Avail: Issuing Activity

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N70-25192 European Organization for Nuclear Research, Geneva (Switzerland).
SOME RECENT TOPICS ON HADRON COLLISIONS
Hong-Mo Chan *In its* Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 1 – 30 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

Finite energy sum rules, duality and exchange degeneracy, and the Veneziano model are discussed. The symmetry properties of the amplitude for finite energy sum rules derivation, generalizations of the rule, and applications to phenomenological analyses are discussed. The rule is then supplemented by assuming that scattering amplitudes are well approximated by the exchange of a few Regge poles and that the imaginary part of a scattering amplitude is dominated entirely by direct channel resonances. Interference models and subtraction of background from resonances are considered. The Veneziano model is illustrated with a pion-pion scattering example. Advantages of the model are considered to be the absence of exotic states, the Adler consistency condition, and the existence of daughter trajectories. Problems associated with the model are the ambiguities and unitarity. N.E.N.

N70-25193 European Organization for Nuclear Research, Geneva (Switzerland).
CHIRAL DYNAMICS
B. Zumino *In its* Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 31 – 45 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

A mathematical discussion is presented on strong interaction phenomena, such as hadron scattering and creation processes, and also the matrix elements of currents. Group theoretical arguments connecting S matrix parameters to form factor parameters are used. Nonlinear chiral transformations and chiral invariant Lagrangian are studied. Expressions are developed for vector currents and the decay of a neutral pion into two gamma particles. N.E.N.

N70-25194 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
INTRODUCTION TO PHOTOPRODUCTION
E. Lohrmann *In* CERN Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 47 – 60 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

A simple general framework of photoproduction is presented. The S matrix element for photoproduction, gauge invariance, current-field identity, isospin, and SU(3) symmetry are discussed. Tests for the invariance property of the photon are listed, and photoproduction of vector mesons is considered. N.E.N.

N70-25195 Paris Univ., Orsay (France). Lab. de l'Accelerateur Lineaire.
PHYSICS WITH ELECTRON-POSITRON COLLIDING BEAMS
J. Haissinski *In* CERN Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 61 – 95 refs (See N70-25191 11-24)
Copyright. Avail: Issuing Activity

Main characteristics of colliding beam rings and results obtained with them are reviewed. Descriptions are given of the magnetic guide field and beam structure; injection, particle spill out, and beam lifetime; beam energy; luminosity and its limitations; and present and future detectors. Data on existing rings, rings being designed, and rings being proposed are tabulated. The positron-electron reactions resulting in Bhabha scattering, two quantum annihilation, and muon production are considered. Strong interactions resulting in hadron production are also discussed, emphasizing the vector mesons. Asymptotic behavior of hadron production cross sections is summarized. N.E.N.

N70-25196 European Organization for Nuclear Research, Geneva (Switzerland).
PLANS FOR PHYSICS WITH THE INTERSECTING STORAGE RINGS
A. Minten *In its* Proc. of the 1969 CERN School of Phys. 19 Nov. 1969 p 97 – 122 refs (See N70-25191 11-24)
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The intersecting storage rings and their operations, and planned experiments are described. The storage rings are two alternating gradient synchrotrons at 45 deg with respect to each other. The stacking process, interaction rate, and luminosity are given, and present knowledge about ultrahigh energy physics is outlined. The future experiments will measure the total pp cross section; elastic scattering; inelastic scattering, diffraction, and exchange reactions; and particle production. N.E.N.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-23907# Texas Technological Coll., Lubbock. Plasma Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF HARMONIC ION CYCLOTRON WAVE PROPAGATION AND PLASMA HEATING Progress Report
M. Kristiansen, M. O. Hagler, and J. E. Cato 15 Nov. 1969 44 p refs
(Contract AT(40-1)-3778)
(ORO-3778-2; PR-2) Avail: CFSTI

An experimental arrangement for the investigation of plasma heating by wave damping near harmonics of the ion cyclotron frequency is described. The waves are excited by coupling pulsed rf energy into a Stix coil, and the waves are damped in a magnetic beach. Both hydrogen and deuterium plasmas are investigated. The plasma is confined in a magnetic mirror configuration with a 1.5 mirror ratio and a maximum flux density of 0.6 Tesla in the Stix coil region. The maximum pulsed rf power level for wave excitation is 170 kW. Diagnostic techniques include electric and magnetic probes, diamagnetic probes, microwave interferometry, spectroscop and others. Further theoretical studies of the harmonic ion cyclotron waves are discussed and some of the approximations made in the quasi-statis ion cyclotron wave theory evaluated. Author (NSA)

N70-23932# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
DEPENDENCE OF VLF ELECTRIC FIELD ANTENNA IMPEDANCE ON MAGNETOSPHERIC PLASMA DENSITY, DECEMBER 1967 - May 1969
H. C. Coons, D. A. Mc Pherson, and W. B. Harbridge 1 Oct. 1969 55 p refs
(Contract F04701-69-C-0068)
(AD-698744; TR-0068(9220-02)-1; SAMSO-TR-69-358) Avail: CFSTI CSCL 4/1

Data from a VLF electric field antenna on board the spacecraft OV3-3 are presented. It is demonstrated that the antenna response depends upon the local plasma density. Antenna impedances, calculated on the basis of a cold, magnetized plasma model and a warm, nonmagnetized, collisionless plasma sheath model, are compared with the data, showing that the sheath model is correct. The response of the electric field antenna to constant onboard sources of electromagnetic interference is used with the antenna sheath impedance model to calculate plasma densities. The resulting densities are similar to those obtained from OGO-2 plasma density data scaled to the OV3-3 orbital parameters. Impedance of the TRW System Group VLF electric field antenna, also on board OV3-3, is calculated and compared with the data. It is shown that the sheath antenna impedance model applies equally well to both antennas even though they were quite dissimilar. Much of the signal variation observed by the Aerospace and TRW electric field antennas is caused by antenna impedance changes as a function of local plasma density. Author (TAB)

N70-23950*# Michigan Univ., Ann Arbor. Electron Physics Lab.
ANOMALOUS DIFFUSION IN A CYLINDRICAL PLASMA COLUMN ABOVE THE CRITICAL MAGNETIC FIELD
R. Hu (Ph.D. Thesis) Feb. 1970 257 p refs
(Grant NGR-23-005-062; Proj. 06621)
(NASA-CR-109450; Rept-06621-18-T; TR-115) Avail: CFSTI CSCL 20I

The anomalous diffusion due to the helical instability in a cylindrical plasma column immersed in a strong external axial magnetic field was investigated. Three effects which were hitherto considered to be negligible in the overall phenomenon are examined in detail namely; electron inertia, finite-amplitude perturbations and the motion of ions. The effect of electron inertia on anomalous diffusion is investigated by including this particular term in the electron fluid equations. The transformed equations reveal that the electron inertia does not play an important role in anomalous radial diffusion so long as the electron cyclotron frequency is much larger than the collisional damping frequency between electrons and neutrals. Nonetheless, the analysis reveals that the electron particle current density in a cylindrical plasma column subjected to an axial static magnetic field is constantly rotating with some superimposed vibration about the local axis of the external magnetic field. Since the rotation is a local one, it should not be observable. Author

N70-23986# California Univ., Livermore. Lawrence Radiation Lab.
PLASMA CONFINEMENT IN HYBRID MULTIPOLE STELLARATOR FIELDS
Charles W. Hartman, Richard H. Munger, and Myron F. Uman 25 Nov. 1969 17 p refs Presented at the Intern. Symp. on Confinement Systems, Dubna, USSR Sponsored by AEC
(UCRL-71721; CONF-690931-1) Avail: CFSTI

Confinement measurements were made of noble gas plasmas (helium, argon, xenon) produced by microwave heating in stellarator or hybrid multipole-stellarator confining fields. The results are described in two broad topics, general confinement properties, and possible loss mechanisms. NSA

N70-23999*# Michigan Univ., Ann Arbor. Radio Astronomy Observatory.
OGO-2 DATA ANALYSIS SATELLITE PLASMA WAKE STUDY Final Report
R. G. Yorks and H. Weil Feb. 1970 76 p ref
(Grant NGR-23-005-314)
(NASA-CR-109457; Rept-70-1) Avail: CFSTI CSCL 20I

The plasma wake of the spinning OGO2- satellite is studied using the 2.5 Mhz antenna impedance data. The method for measuring antenna impedance is described. The very strong wake modulation recorded in the inductive region up to the time the reactance goes capacitive is considered a significant wake feature, and is believed to be an impedance effect caused by the continually varying angle between the antenna and the magnetic field lines as the spacecraft spins. The paper OGO satellite wake structure deduced from antenna impedance measurement, and the outlines of computer programs written for this study are included. F.O.S.

N70-24014# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
PLASMA INSTABILITIES AND WAVE EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE Annual Progress Report
J. L. Shohet 15 Dec. 1969 65 p refs
(Contract AT(11-1)-1695)
(COO-1695-25) Avail: CFSTI

The research performed under this contract involves the study of plasmas produced by electron cyclotron resonance heating in a magentic mirror device. Specifically, the work has centered on three major problems: The measurement of free-free bremsstrahlung from the plasma and the theoretical problem of relating the results to the electron energy distribution. The measurement of parallel and perpendicular electron energies by means of an analyzer and diamagnetic loop along with microwave diagnostics, and the comparison of the results with theoretical predictions and with the results of computer simulation. The investigation and identification of an electromagnetic instability. This report summarizes the progress in the above areas during the period of December 15, 1968 to December 14, 1969 and outlines a program for further theoretical and experimental effort. Author (NSA)

N70-24026# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
CALCULATION OF ELECTRON TEMPERATURE PROFILE ACROSS A SHOCK WAVE IN A NONEQUILIBRIUM PARTIALLY IONIZED GAS FLOW
G. Kamimoto, M. Nishida, and T. Inui Dec. 1968 32 p refs
(CP-26) Avail: CFSTI

The electron temperature profile across a normal shock wave in a nonequilibrium, partially ionized gas flow was calculated for both cases of chemically frozen flow and recombining flow. For

the former case, the calculation was made by extending Grewal et al.'s method, and this result was compared with the result obtained by integrating directly the electron energy equation by Runge-Kutta-Merson method. For the recombining flow case, the continuity equation and the energy equation of the electrons were directly integrated, assuming that the three body recombination and the radiative recombination were dominant. Author

N70-24032# Air Vehicle Corp., San Diego, Calif.
IONIZING FRONTS IN PLASMA PROPULSION AND POWER GENERATION SYSTEMS Final Scientific Report 1964 - 1969
Jan. Rosciszewski Jul. 1969 191 p refs
(Contracts AF 49(638)-1357; AF 49(638)-1556; F44620-68-C-0052)
(AD-699253; AFOSR-69-2160TR) Avail: CFSTI CSCL 20/9

Analytical work associated with plasma propulsion and power generation systems is discussed. Some papers are relatively closely related to experimental work and are designed to describe analytically the physical phenomena in plasma propulsion and power generating systems. Other work represents feasibility studies of new concepts in these fields. Another group of papers represents development of an analytical tool applicable to analysis of flow interacting with an electromagnetic field. Author (TAB)

N70-24087# Princeton Univ., N.J. Plasma Physics Lab.
THERMOKINETIC EXPANSION THEORY
John M. Dawson Dec. 1969 14 p refs
(Contract AT(30-1)-1238)
(MATT-736) Avail: CFSTI

The expansion of a hot plasma into a vacuum is discussed. Both spherical and nonspherical expansions are described, with emphasis on the physics. Similarity solutions are presented. The absorption of laser radiation by a nonuniform plasma is also discussed. It is found that an overdense plasma effectively absorbs laser radiation if the scale length for density falloff is greater than the distance that light travels in an electron-ion collision time. Author (NSA)

N70-24088# Princeton Univ., N.J. Plasma Physics Lab.
EFFECT OF NEUTRAL PARTICLES AND SUPPORTS ON THE CONFINEMENT OF PLASMAS IN THE SPHERATOR
S. Yoshikawa, R. Freeman, and M. Okabayashi Nov. 1969 20 p refs Presented at the 11th Ann. Meeting of the Div. of Plasma Physics, Los Angeles, Calif.
(Contract AT(30-1)-1238)
(MATT-706; CONF-69/105-1) Avail: CFSTI

A model is proposed to explain the neutral-pressure dependence of the confinement time observed in the spherator. The theory predicts that the existence of supports causes a density variation on the magnetic surfaces, and the resulting electric field gives an anomalous diffusion across the magnetic field. The theoretical values are both qualitatively and quantitatively in agreement with the experimental values, for several different gases. Author (NSA)

N70-24132# Avco-Everett Research Lab., Everett, Mass.
COMPARISON OF EXPERIMENTAL AND ANALYTICAL RESULTS FOR A 20 MW COMBUSTION-DRIVEN HALL CONFIGURATION MHD GENERATOR
O. K. Sonju, J. Teno, and T. R. Brogan Nov. 1969 26 p refs
(RR-344) Avail: CFSTI

The results of a continuing effort to upgrade "design" and "off design" analytical techniques for MHD generators are reported. The analytical techniques are applicable to all types of generators, but the work reported is primarily concerned with the analysis of Hall MHD generators. The analytical techniques used in the analysis including boundary layer analysis, gas nonuniformity considerations, and electrode drop effects, are reviewed. As a check on the analysis, comparisons between predicted and observed operating parameters of a 20 MW Hall generator are made. Although some small discrepancies still exist, the correlation between predicted and observed performance is very good. The analysis is shown to predict the maximum loading (stalling point) of Hall generators accurately. Based on the conclusion that the analysis is quite accurate in view of the comparisons and checks made, it is felt that these analytical techniques can be used with some confidence to design and predict the performance of future MHD generators with a high degree of accuracy. Author

N70-24251*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS FROM OGO-5 OF THE THERMAL ION DENSITY AND TEMPERATURE WITHIN THE MAGNETOSPHERE
G. P. Serbu and E. J. R. Maier Jan. 1970 39 p refs
(NASA-TM-X-63871; X-615-70-34) Avail: CFSTI CSCL 20I

The OGO-5 retarding potential analyzer experiment is operated in a voltage mode designed to yield the integral spectrum of both ions and electrons in the energy interval from 0 eV to 500 eV. Detailed results obtained with the spacecraft inside 7 R sub E during the first 15 orbits (March - April 1968) are presented. Identification and grouping of the data into three types of density profile is presented. First, a smooth decrease in ion density. A second general type of observed density profile is typified by considerable structure within the plasmasphere and the plasmapause is identified by a factor of 3 or more drop in ion density. The third type of profile shows a density drop of a factor of 20 or more inside the L = 7 R sub E radial distance to values below our minimal detectable level. Author

N70-24294# California Univ., Berkeley. Lawrence Radiation Lab.
CYCLOTRON ECHOES IN Cs VAPOR
John Wesley Shaner Oct. 1969 99 p refs
(Contract W-7405-eng-48)
(UCRL-19085) Avail: CFSTI

Cyclotron echoes have been studied in a weakly ionized cesium plasma in a magnetic field. The behavior of the multiple echoes following two resonant microwave pulses (two-pulse echoes) and those following three resonant microwave pulses (three-pulse echoes) are shown for various pulse spacings and neutral Cs densities. These results are compared with various theoretical models. On the basis of this comparison, the velocity dependence of the electron - neutron collision frequency is chosen as the mechanism for two-pulse echo generation. Several mechanisms are invoked to explain the three-pulse echoes, including scattering without diffusion and diffusion across flux lines. A detailed comparison is made between the results from these models and the experimental results. Author (NSA)

N70-24319*# California Univ., Berkeley. Dept. of Physics.
VALIDITY OF THE ELECTROSTATIC APPROXIMATION
David Montgomery Oct. 1969 9 p refs
(Grant NGL-05-003-220)
(NASA-CR-109396) Avail: CFSTI CSCL 20I

Criteria are derived for the existence of normal modes in a magnetized plasma and their solutions. The condition is different from the frequently quoted condition of thermal pressure is much less than magnetic pressure. Author

N70-24337# New York Univ., N.Y. AEC Computing and Applied Mathematics Center.
COLLECTIVE MODES IN AN INHOMOGENEOUS ELECTRON GAS
Joyce Newman and Jerome K. Percus Oct. 1969 157 p refs
(Contract AT(30-1)-1480)
(NYO-1480-127) Avail: CFSTI

This study is paralleled after J. Hubbard's treatment of collective modes in the uniform electron gas and differs mainly in the mathematical complexity. Large contributions to the correlation energy are identified with collective modes and this identification provides conditions for the frequency and lifetime of these modes. The contributions to the correlation energy are analyzed via

diagrammatic techniques where the Coulomb interaction between the electrons is replaced by a modified interaction. Only first-order or bubble diagrams are considered, and this is equivalent to the random phase approximation. The modified interaction is obtained from a certain integral equation whose solution is approximated by a variational principle. The kernel of this integral equation depends upon the density operator for the system of electrons with an external potential. Author (NSA)

N70-24389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF AN APERTURE ON MEASUREMENT OF THE AXIAL DISTRIBUTION FUNCTION IN A MAGNETICALLY CONFINED PLASMA
Roman Krawec Washington Apr. 1970 42 p refs
(NASA-TN-D-5746; E-5447) Avail: CFSTI CSCL 20I

Theoretical calculations have been performed to determine the distortion in the axial velocity distribution when a magnetically confined plasma passes through an aperture. A general solution is obtained in terms of aperture length to radius ratio, transverse to axial temperature ratio, and normalized length. Results are shown for magnetic field strengths ranging from zero to infinity. It is found that the use of strong magnetic fields allows the aperture to pass a plasma sample from which the true axial distribution function may be obtained. Author

N70-24381*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ONE-DIMENSIONAL TIME-DEPENDENT INTERACTION OF A SATELLITE WITH THE IONOSPHERIC PLASMA
Nobie H. Stone and John W. Sheldon (Florida State Univ.) Washington Apr. 1970 46 p refs
(NASA-TR-R-335; M431) Avail: CFSTI CSCL 20I

A theoretical study and numerical solution are presented for the one-dimensional, time dependent problem of a streaming, nonuniform, fully ionized, collisionless plasma impinging upon a stationary, flat conducting plate oriented perpendicularly to the flow of the plasma. The problem is intended to model the interaction of the frontal surface of a satellite with the ionospheric plasma. The time-dependent equations that describe the one-dimensional problem are established, and from them the steady-state equations are derived. These steady-state equations are solved for the spatial dependence of the electric field, which is seen to be a reasonable form and to agree with previous work on more complicated configurations. Finally, a numerical method of solving the time-dependent equations is presented and applied to two special cases: (1) for a plate that has no initial charge, and (2) for a system that is initially in an equilibrium state and proceeds to a second equilibrium state because of a step transition in the plasma parameters. Author

N70-24404# European Space Research Inst., Frascati (Italy).
PARALLEL PROPAGATION OF NONLINEAR LOW FREQUENCY WAVES IN HIGH BETA PLASMA
Andre Rogister [1969] 10 p refs Submitted for publication
Avail: CFSTI

The nonlinear evolution of low frequency, large scale-length (compared to the ion Larmor radius and gyrofrequency) perturbations propagating parallel, or nearly parallel, to the equilibrium magnetic field in a high beta plasma was investigated. A procedure to reduce the Vlasov-Maxwell equations to a pair of coupled, nonlinear, partial differential equations describing this evolution is outlined. Author (ESRO)

N70-24405# European Space Research Inst., Frascati (Italy).
SPACE CHARGE EFFECTS IN PLASMA PARTICLE ANALYZERS
T. S. Green [1969] 20 p refs Submitted for publication
Avail: CFSTI

The effects of space charge on the energy resolution obtainable with deflection type particle analyzers has been considered previously for cylindrical beams. In the present analysis two other problems are considered: the effect of space charge on retarding potential analyzers and the effect on deflection analyzers using ribbon beams. In one case a longitudinal electric field exists, and in the latter a transverse field. A treatment of the two dimensional case is also presented which allows one to derive the correct transverse and longitudinal fields taking into account the correct boundary conditions, for a simple situation. Author (ESRO)

N70-24409# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
PLASMA MOTION AND EQUILIBRIUM IN UNSYMMETRIC MAGNETIC FIELDS
B. Lehnert 20 Jan. 1970 32 p refs
(Rept-70-01) Avail: CFSTI

The motion and equilibrium are investigated of a plasma confined by an unsymmetric magnetic field where the lines of force are closed. The equilibrium of the plasma is analyzed in terms of the motions in alpha beta space. Within the limits of first order orbit theory, stationary equilibria should become possible without severe restrictions, provided that local fluid velocities are allowed to exist in the plasma. For a particular class of such equilibria an electric field can be set up which, on the average, keeps the plasma at rest on each field line. A modified deduction is presented of the average guiding center drifts from field line to field line in the space defined by the magnetic field. The contributions from the electric field and the magnetic gradient to these drifts are treated separately, and the average effects arising from charge separation phenomena are discussed. Author (ESRO)

N70-24417# California Univ., Los Angeles. School of Engineering and Applied Science.
FEEDBACK STABILIZATION OF HIGHLY CONDUCTING PLASMAS
P. K. C. Wang 15 Dec. 1969 8 p refs
(Contract AF-AFOSR-1547-68)
(AD-698810; AFOSR-69-3119TR) Avail: CFSTI CSCL 20/9

A general result for the feedback stabilization of surface instabilities of a highly conducting plasma is presented. Explicit form of feedback for stabilizing a linear pinch with a uniform axial magnetic field is given. Author (TAB)

N70-24448*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A FUNDAMENTAL STUDY OF THE CURRENT DENSITY DISTRIBUTION IN A FLOWING NONEQUILIBRIUM PLASMA
Chong S. Kim Sep. 1969 78 p refs
(Grants NGR-52-026-012; NRC A-3950)
(NASA-CR-109401; UTIAS-TN-143) Avail: CFSTI CSCL 20I

In order to determine the current distributions in MHD channels in non-uniform plasma flow, the electrical conductivity and the Hall parameter are formulated in the form of the second approximation. A successive iteration procedure is chosen, by which the electron temperature calculated during successive iterations provides the new spatial distribution of plasma parameters at this step of the iteration. The numerical solutions to the current and electron temperature distributions for uniform conductivity and Hall parameter less than one show diagonally symmetric patterns in a Faraday type channel. This result can be used as a first iteration for the solution of non-uniform plasma. Author

N70-24479# Plasma Sciences Labs., Inc., Van Nuys, Calif.
TEMPERATURE MEASUREMENTS IN SEEDED AIR AND NITROGEN PLASMAS Final Report, 15 Jun. 1968 - 25 Jul. 1969
H. N. Olsen, G. Bedjai, and F. L. Kelly Arnold Air Force Station, Tenn. AEDC Jan. 1970 135 p refs
(Contract F40600-68-C-0006)
(AD-699200; AEDC-TR-69-275) Avail: CFSTI CSCL 20/9

Temperatures in the range of 2500 to 5000K were measured in the seeded air and nitrogen plasmas produced with a 2 megawatt arc heater. Two specially designed spectra probes were used for these measurements. Mass seed rates of potassium carbonate ranged from 0 to 1.88% by weight of potassium and power levels ranged from 300 kw to 1000 kw. Temperatures determined from measured intensities of the continuous radiation and from atomic spectral lines of potassium were found in the seeded plasmas to agree satisfactorily with the static temperatures determined aerodynamically from an experimentally measured energy balance. Because of the strong dependence of intensity on temperature in the low range encountered, the observed intensity fluctuations in the jet resulted in less than a 10% change in temperature. Corrections of the seed lines for self-absorption brought the measured temperatures within 2% of those obtained from the continuum. The continuous radiation from unseeded air and nitrogen plasmas was measured to be about a factor of 15 higher than any existing theory predicts. Author (TAB)

N70-24519# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF THE NEUTRALIZATION PLASMA IN THERMIONIC CONVERTERS Final Report, 1 Oct. 1966 – 31 Oct. 1969
Rodney J. Andersen, William L. Nighan, and Robert H. Bullis 31 Oct. 1969 71 p refs
(Contract F19628-67-C-0069)
(AD-698821; UARL-H920499-13; AFCRL-69-0471) Avail: CFSTI CSCL 10/2

An investigation was directed toward obtaining an improved understanding of the properties of the cesium neutralization plasma existing in ignited-mode thermionic converters. Toward this end an analysis was made of electron and ion transport phenomena based on conditions known to exist in thermionic converter plasmas. In support of this analysis, detailed measurements of electron density and temperature in the ignited-mode converter plasma were made using high resolution spectroscopic techniques. With this information, quantitative estimates were made of the electric field intensity, the electron kinetic energy flux, the ion current density, and the charged particle production rate. On the basis of these results, an interpretation was made of the role played by the cesium neutralization plasma in determining converter performance. Author (TAB)

N70-24742# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ANALYTICAL TREATMENT OF RADIATION AND CONDUCTION LOSSES IN THERMAL INDUCTION PLASMAS Research Report, Jun. 1968 – Jan. 1969
Hans U. Eckert 7 Nov. 1969 35 p refs
(Contract F04701-69-C-0066)
(AD-698330; TR-0066(5220-50)-5; SAMSO-TR-69-386) Avail: CFSTI CSCL 20/9

Approximate solutions have been obtained of the Elenbaas-Heller equation for a two-zone model of thermal induction plasmas. In this model, most of the heat production takes place in an external zone where it is balanced by heat conduction, radiation losses being negligible in this region. Most of the heat so generated is conducted to the walls, but a small fraction of it is conducted inward and forms the principal heat source for the second, internal, zone. Radiation is the dominant loss mechanism in this inner region. Under these conditions, the distribution of the heat conduction potential assumes a parabolic shape for the inner zone, whereas it is described by Bessel functions in the external zone. A coordinate transformation in this zone accounts for the nonuniformity of the induced electric field and explicitly shows the effect of skin depth upon the profile shape. Matching of the zonewise solutions yields temperature distributions that are continuous to the first derivative and display the characteristic minimum at the axis known from experimental work. Generalized charts are presented by which a particular profile can be calculated from the gas transport properties and the time rate of change of primary magnetic flux. Author (TAB)

N70-24902*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A REVERSE HYDROMAGNETIC SHOCK IN THE SOLAR WIND
L. F. Burlaga Mar. 1970 15 p refs Submitted for publication
(NASA-TM-X-63882; X-692-70-95) Avail: CFSTI CSCL 20I

A reverse hydromagnetic shock in the solar wind is identified. The shock surface is oriented along the spiral direction, and it separates a high speed stream from a compressed, anomalously hot plasma ahead of the stream. Author

N70-24920# Technische Hogeschool, Eindhoven (Netherlands).
ON THE NONLINEAR THEORY OF ONE-DIMENSIONAL HOMOGENEOUS COLLISIONLESS PLASMAS
Robert Willem Borel Best (Ph.D. Thesis) 24 Feb. 1970 68 p refs
Avail: CFSTI

Three papers are reprinted which support the nonlinear theory of one dimensional homogeneous collisionless plasmas. The first paper is on the motion of charged particles in a slightly damped sinusoidal potential wave. An adiabatic invariant for the particle's nearly periodic motion is discussed. The time average energy and momentum of a particle, free particles accelerated in a damped wave, and the so-called nonlinear Landau damping are discussed. The second paper is on the motion of charged particles in a self-consistent standing potential wave. Equations of Vlasov and Poisson describing one dimensional plasma motion are solved. The third paper deals with the motion of charged particles in a self-consistent continuous spectrum of waves. S.S.

N70-25019 Polytechnic Inst. of Brooklyn, N.Y.
ELECTROMAGNETIC WAVE PROPAGATION IN UNIAXIAL PLASMAS WITH CURVED MAGNETIC FIELD
Henry John Stalzer, Jr. (Ph.D. Thesis) 1969 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-20372

The effect of the curvature of an impressed static magnetic field on the propagation and diffraction of electromagnetic waves in a uniaxial plasma is studied. The model chosen for the analysis is two dimensional with the magnetic field lines consisting of concentric circles. Ray optical techniques are used to construct approximate solutions to the field radiated from a line source in the unbounded medium and one into which a perfectly conducting or a transparent cylinder is introduced. The radiated, reflected, refracted and diffracted fields calculated by ray optics are then validated by obtaining exact integral representations for the solutions to several canonical problems and evaluating these integrals asymptotically for high frequencies. The agreement between the ray optical results and the asymptotic approximations validates the ray optical procedure and suggests its usefulness in obtaining approximate solutions to more general configurations which are not amenable to a rigorous analysis. Dissert. Abstr.

N70-25047# Atomic Energy Commission, Washington, D.C.
FORMING HIGH-FREQUENCY FIELDS IN PLASMA DEVICES
G. I. Zverev et al [1969] 13 p refs Transl. into ENGLISH from Russian report NP-17893
(AEC-tr-7118; NP-17893) Avail: CFSTI

Systems designed for producing high-frequency magnetic fields of various configurations in the frequency range from 0.1 to 5 mHz are described. The fields are developed by currents in symmetrical eight-bar windings, which together with the connected capacitors, form resonance contours for powerful vacuum-tube oscillators. Data are given on the design and performance of high-frequency generators using pulsed-generator triodes of Soviet construction. NSA

N70-25092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPLORER 22 ELECTROSTATIC PROBE DATA ANALYSIS TESTING THE RESULTS FOR ACCURACY

E.J. Gregg Mar. 1970 21 p Submitted for publication
(NASA-TM-X-63879; X-621-70-71) Avail: CFSTI

Computer analysis of electrostatic probe data from approximately 10,000 passes has been completed. From a selection of data corresponding to a wide range of electron temperature and density, a detailed comparison was made with hand and computer methods. The accuracy of the initial analysis was better than 10% in most of the passes. Errors exceeding this value were found to be caused by the following: (1) curves taken in the wake of the satellite were not always excluded from the analysis. (2) The curves with limited ions reference were sometimes analyzed improperly by the program. (3) The program sometimes failed to select the proper detector range for the most accurate analysis of electron temperatures. Author

N70-25144# Atomic Energy Commission, Washington, D.C.
EXTENSION OF THE RANGE OF MEASUREMENT OF PLASMA DENSITY BY MEANS OF A LASER INTERFEROMETER WITH PHASE MODULATION OF THE VISUAL SIGNAL
L.A. Dushin et al [1969] 10 p refs Transl. into ENGLISH from Russian report FTI-165
(AEC-tr-7114; FTI-165) Avail: CFSTI CSCL 20I

A laser interferometer, capable of measuring nL of plasma from 10 to the 14th power to 10 to the 17th power el/sq cm, is discussed (n is electron density and L is path length signal). NSA

N70-25188*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
PULSED ELECTROMAGNETIC GAS ACCELERATION Semiannual Progress Report, 1 Jul. – 31 Dec. 1969
Robert G. Jahn, Woldemar F. von Jaskowsky, and Kenn E. Clark 1 Jan. 1970 58 p refs
(Grant NGL-31-001-005)
(NASA-CR-109408; AMS-634n; SAPR-15) Avail: CFSTI CSCL 20I

Exhaust velocities far in excess of the Alfven critical speed are observed in the exhaust of a quasi-steady, self-field MPD accelerator, over a range of arc currents up to 42,000 A. Although the measured velocities correspond roughly to the total electrode voltages, an electrostatic ion acceleration mechanism is not supported by detailed maps of the potential contours within the arc chamber. Rather, it is found that the bulk of the arc voltage gradient, exclusive of the electrode falls, occurs within two diameters of the cathode, and is normal to it. Anode fall voltage varies inversely with local current density, implying substantially lower anode losses at higher power arc operation. Minimum anode fall appears to coincide with matched mass flow operation. Bow shocks from small obstacles placed in the exhaust stream indicate supersonic, but not hypersonic flow, and imply ion temperatures of the order of 10 eV. Electron temperatures at the same location appear to be substantially lower. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-23929# Duke Univ., Durham, N.C. Dept. of Electrical Engineering.
A STUDY OF SPIN WAVES IN UNENCUMBERED FERROMAGNETIC NI AND FE FILMS Final Report, 17 Nov. 1964 – Sep. 1969
John L. Artley Sep. 1969 8 p
(Grant DA-ARO(D)31-124-G619)
(AD-698554) Avail: CFSTI CSCL 20/12

A summary of work completed in the study of spin waves in thin ferromagnetic films is given. A theoretical model which includes damping and surface conditions is used to develop a computer program to predict resonance peak heights and spacing as well as the distribution of the rf field across the film with perpendicular pumping. An ion beam deposition system is described from both a theoretical and experimental approach. Thin indium films are deposited using the ion beam deposition system to obtain spot diameters of 0.075 cm. with beam currents of 0.000 000 01 amperes. The practical limit on resolution for this system is set by chromatic aberration. This limit can be reduced by improved ion sources. The sputtering of indium ions impinging on indium targets reaches unity at about 550 eV as compared to predicted values of 200 eV. Author (TAB)

N70-24002# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ELECTRON MEAN FREE PATH NEAR 2 keV IN ALUMINUM, JULY 1967 – JUNE 1968
H. Kanter 31 Oct. 1969 17 p refs
(Contract F04701-69-C-0066)
(AD-698746; TR-0066(9230-01)-2; SAMSO-TR-69-398) Avail: CFSTI CSCL 20/12

The mean free path for elastic scattering and for plasmon production was determined from beam attenuation measurements on films of various thicknesses. Author (TAB)

N70-24078# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
H CENTER ANNEALING IN GAMMA IRRADIATED KBR
A. Taylor and W. Fuchs Sep. 1969 13 p refs Presented at the 10th European Congr. on Molecular Spectroscopy, Liege, Belgium Supported in part by AEC
(NYO-3822-17; CONF-690932-1) Avail: CFSTI

A study was made of the annealing kinetics of H centers in KBr crystals irradiated at 10 K by Co-60 gamma rays. The absorption spectrum, luminescence, and conductivity glow peaks were measured. The annealing of the H band at 380 nm and of the thermoluminescence was followed at various temperatures; peaks were observed at 27, 40 and 50 K. It appears that the 27 K peak comprises processes with two distinct activation energies. The annealing kinetics are analyzed. It is suggested that the H center anneals by lattice recombination, and that this occurs by interstitial migration to F centers. NSA

N70-24314# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
X-RAY DETERMINATION OF ELECTRON DISTRIBUTION IN CRYSTALS. PART 4. ELECTRON DISTRIBUTION IN ALUMINUM (1, 2, 3, 4) [ROETGENOGRAPHISCHE BESTIMMUNG DER ELEKTRONENVERTEILUNG IN KRISTALLIN. IV. DIE ELEKTRONENVERTEILUNG IM ALUMINUM 1, 2, 3, 4]
H. Bensch et al Nov. 1969 32 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 4, 1955 p 65–88 Prepared for Lincoln Lab., MIT
(AZT-69-630-GELL) Avail: CFSTI

Aluminum monocrystalline plates manufactured according to two different processes were investigated with respect to lattice dislocations, and the integral reflectance of all reflexes up to (10, 0, 0) were measured on three selected parallel (1, 1, 0) ground standard plates. After taking extinction into account, the structural amplitudes and with them the distribution of the electron density in the x, y, o plane were computed. The load distribution of the ions is spherically symmetric within measurement error, and at no point between the ions does the electron density decrease to zero. The mean value of the electron density between the atomic torsos leads to approximately 3 conduction electrons/atom. Author

N70-24325# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INTERDIFFUSION BETWEEN Hg Te AND Cd Te IN THE

SOLID STATE: EXPERIMENTAL RESULTS AND INTERPRETATION [INTERDIFFUSION A L'ETAT SOLID ENTRE HgTe ET CDTE: RESULTATS EXPERIMENTAUX ET INTERPRETATION]

Francis Bailly Jan. 1970 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 262, 1966 p 635-638 Prepared for Lincoln Lab., MIT
(AZT-70-58-FRLL) Avail: CFSTI

Experimental results obtained on the nature of flaws present in the interdiffusion of solid state mercury and cadmium tellurides are considered. An interpretation of these is given on the basis of a microscopic model (creation and migration of various flaws). Author

N70-24359# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SLOW ELECTRON MEAN FREE PATHS IN ALUMINUM, SILVER, AND GOLD

Helmut Kanter 1 Jul. 1969 69 p refs
(Contract F04701-69-C-0066)
(AD-698743; TR-0066(9230-01)-1; SAMSO-TR-69-380) Avail: CFSTI CSCL 20/12

Beam attenuation measurements were made on free-standing polycrystalline films of various thicknesses at energies between the work function and several electron volts above. The electron-electron collision mean free paths were determined by correction of the attenuation lengths for electron-phonon scattering lengths deduced from the attenuation temperature dependence. Imperfection mean free paths were negligible. Results are discussed. TAB

N70-24396 Pennsylvania Univ., Philadelphia.
SOME PROPERTIES AND APPLICATIONS OF JOSEPHSON TUNNEL JUNCTIONS

Arnold Morton Denenstein (Ph.D. Thesis) 1969 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-21338

Josephson tunnel junctions are studied with special attention to characteristics of importance in a variety of device applications. A Josephson tunnel junction is composed of two thin films of superconductor separated by an insulating barrier. At temperatures below the superconducting transition temperatures of the two superconductors, phase coherent tunneling of bound superconducting pairs can occur. The electrodynamic properties of Josephson tunnel junctions have been studied in order to investigate their potential as sources and detectors of electromagnetic radiation. In addition, their properties as frequency-voltage transducers have been studied in connection with their possible application as dc voltage standards. Dissert. Abstr.

N70-24454# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Departement d'Etudes et de Recherches en Technologie Spatiale.
STUDY OF THE METALLIC ADHESION IN VACUO [ETUDE DE L'ADHESION METALLIQUE DANS LE VIDE]

J. C. Hennequin Dec. 1969 53 p refs In FRENCH
(ONERA-NT-03-4-69) Avail: CFSTI

Mechanical aspects (temperature effects, surface contamination and cleanliness, variation in gaseous environments) are emphasized. The physico-chemical aspects of metal-metal bonding are reviewed, especially surface energy, energy of formation, mutual solubility of metallic surfaces, and the influence of the electronic and crystalline structures of metallic interfaces. ESRO

N70-24462 Minnesota Univ., Minneapolis.
FLUCTUATION PHENOMENA IN GALLIUM ARSENIDE

LeRoy Harvey Anderson (Ph.D.Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-19997

The noise spectra of the high ohmic GaAs crystals (doped with zinc and counterdoped with various materials) indicate that only electronic fluctuations contribute (generation-recombination noise, occasionally diffusion noise). The spectra have much structure in the range 10 Hz - 1 MHz with relaxation modes near 40 Hz, 10 kHz, and one or more modes in the middle range. Measurements at 77 K under optical excitation give entirely different spectra. Positive and negative modes (the latter characterized by peaks) occur. For long wavelengths and for strongly absorbing light the noise is high and the spectra are structureless which is attributed to surface traps. With light near the band gap, much structure is observed; these spectra result presumably from cyclic transitions, i.e., direct excitation and recombination through oxygen levels and other states. The capture cross sections are close to those obtained from the thermal data. Dissert. Abstr.

N70-24608# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
THE 4-6 SEMICONDUCTING COMPOUNDS: DATA TABLES

M. Neuberger Oct. 1969 111 p refs
(Contract F33615-68-C-1225)
(AD-699260; EPIC-S-12) Avail: CFSTI CSCL 20/12

The tables include the most reliable information available to date for every property mechanical, crystallographic, physical, thermal, magnetic, electronic and optical of each of the 4-6 binary semiconducting compounds. This volume contains data concerning the oxides, sulfides, selenides, and tellurides of germanium, lead, and tin. TAB

N70-24623# Academy of Sciences (USSR), Moscow. Inst. Atomnoi Energii.
HARMONIC FOCUSING EFFECT

I. V. Al'Tovski 1968 8 p refs In RUSSIAN
(IAE-1772) Avail: CFSTI

A mechanism based on dynamic harmonic theory is proposed for forming focused low-energy collisions. Experiments with neutron irradiation of crystals indicate the existence of long-range (of the order of several lattice constants) interaction between defects during irradiation. NSA

N70-24641# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THEORETICAL AND PRACTICAL STUDIES OF DIELECTRIC APPLICATIONS OF FERROELECTRICS [THEORETISCHE UND PRAKTISCHE UNTERSUCHUNGEN UEBER DIELEKTRISCHE ANWENDUNGEN VON FERROELEKTRIKA]

Arvind Shah (Ph.D. Thesis) 1969 108 p refs In GERMAN; ENGLISH summary *Its* Dissertation No. 4059
Avail: CFSTI

Formulas are obtained for the dielectric nonlinearity of a ferroelectric crystal, the temperature drift of a ferroelectric amplifier, the thermodynamic efficiency of a ferroelectric energy converter, and the temperature dependence of a ferroelectric analog memory. A ferroelectric amplifier built with any of the common ferroelectric materials will always have a large temperature drift. The formulas are compared with experimental results for triglycine sulphate (TGS). A brief comparison between ferroelectrics and ferromagnetics follows. Author

N70-24705# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany). Sektor Elektronik.
INVESTIGATION OF THE INFLUENCE OF IONIZING IRRADIATION ON THERMALLY OXIDIZED SILICON SURFACES BY MEANS OF THE FIELD EFFECT [UNTERSUCHUNG DER WIRKUNG IONISIERENDER STRAHLUNG AUF THERMISCH OXIDIERTE SILIZIUM-OBERFLAECHEN MIT HILFE DES FELDEFFEKTES]

H. G. Wagemann (Ph.D. Thesis) Nov. 1969 136 p refs In GERMAN; ENGLISH summary
(HMI-B-90; BEW-21) Avail: CFSTI

Starting with the process of thermal oxidation of silicon, the positive charge of the oxide layer (interface charge) and of the interface between oxide and semiconductor (interface states) is

discussed. They are evaluated experimentally by means of the field effect admittance and of the noise current before and after mainly ionizing irradiation. The results indicate that the density of surface states increases according to its amount without changing its energy distribution. The interface states at the middle of the band gap prove to be surface recombination centres. Author

N70-24709 Johns Hopkins Univ., Baltimore, Md.
MIXING AND ENERGY RELAXATION IN INDIUM ANTIMONIDE
James J. Whalen (Ph.D. Thesis) 1969 202 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-21056

The performance of bulk n-type indium antimonide mixers and the theory of electron energy relaxation in the bulk material are investigated. A heterodyne experiment has been performed at 69 GHz with intermediate frequencies varying from 0.4 to 20 MHz. In this experiment the conversion loss is measured as a function of intermediate frequency for ambient temperatures in the range 1.5 -20 K. The intermediate frequency at which the conversion loss increases by 3dB determines the response time. An expression directly relating response time and energy relaxation time is derived, and good agreement between theory and experiment is shown. Dissert. Abstr.

N70-24712 Johns Hopkins Univ., Baltimore, Md.
BULK AND SURFACE CONDUCTION IN METAL-FREE PHTHALOCYANINE
David Franklin Barbe (Ph.D. Thesis) 1969 196 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-21110

Measurements were made to determine the dependence of the current density in the square-law region of the I-V curves on crystal thickness. The current density was found to be inversely proportional to the cube of the crystal thickness; therefore, the current density in the square-law region is space-charge limited. Measurements of the temperature dependence of the space-charge-limited current were used to determine the bulk trapping parameters. In a vacuum of 5 × 10 to the minus 9th power torr, an electron-trapping level was found at an energy 0.38 eV below the edge of the conduction band. The density of tapping centers at this level was approximately 10 to the 19th power 1/cu cm. Ambient gases were found to affect the bulk conductivity by diffusing into the bulk and thereby introducing additional trapping levels near the center of the band gap. Temperature dependence measurements in the ohmic region indicated that there were also approximately 10 to the 12th power 1/cu cm donors at the level 0.38 eV below the conduction-band edge; therefore, the ohmic conduction is not intrinsic. Dissert. Abstr.

N70-24905 Carnegie-Mellon Univ., Pittsburgh, Pa.
DEVELOPMENT, USING COMPUTER ANALYSIS, OF A SELECTIVE AXIAL DETECTION ELECTRON DIFFRACTION SYSTEM
John Lewis Gilmer (Ph.D. Thesis) 1969 230 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-19092

This thesis describes improvements and further computer-aided analysis of the selective axial detection electron diffraction system designed and described by H. J. Nee for her doctoral thesis. The system allows diffraction patterns from thin film samples to be interpreted electronically and thus almost instantaneously. The method is useful in the study of crystallographic changes in such thin films during growth or during the annealing process following deposition. The diffracted electrons proceed along the elements of right circular cones. The axis of these cones is the extension of the incident beam. An axially symmetric electrode placed on the axis has equal effect on all electron trajectories in a specific cone. For any particular diffracted cone of electrons, there exists a voltage, which when applied to the axially symmetric deflection electrode causes all the electrons in the cone to enter a detector on the axis and be counted. Dissert Abstr.

N70-24999 Stevens Inst. of Tech., Hoboken, N.J.
X-RAY METHODS FOR INTERNAL STRESS MEASUREMENT IN SINGLE CRYSTALS
S'Keng Pan (Ph.D. Thesis) 1969 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-21299

The two-plane method of X-ray stress measurement of single crystals was developed. Two diffraction lines were measured, one from a plane which is nearly parallel to the crystal surface, and one from a plane which is inclined at an angle. The interplanar spacings were determined from the center of gravity of rocking curves. The crystals were aligned with a precision three-rotation goniometer. Computer programs were devised for the corrections of crystal alignment errors and the determinations of the stress and the true lattice parameter of the crystal tested. The accuracy, reproducibility and feasibility of the two-plane method was evaluated with copper, nickel, and niobium crystals. The results from the two-plane methods were also compared with those from an internal-standard technique using vapor-deposited nickel, (001)-oriented films on potassium-chloride cleavage faces, as well as with those where strain gages were mounted on a niobium crystal. Dissert. Abstr.

N70-25014# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF CONDUCTION BANDS OF CADMIUM ARSENIDE [CONTRIBUTION A L'ETUDE DES BANDES DE CONDUCTION DE L'ARSENIURE DE CADMIUM CD3AS2]
Nicole Sexer 1969 84 p refs In FRENCH
(NT-168) Avail: CFSTI

The structure of conduction bands of a semiconductor composed of cadmium arsenide, Cd3As2, is considered. The investigative model utilizes the classical phenomenon of transport. The proposed model has two conduction band lengths of 0.15 eV and effective masses of 0.6 and 0.12 for the free electron mass. Transl. by J.M.C.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-24155# Massachusetts Inst., of Tech., Cambridge. Fluid Mechanics Lab.
EXPERIMENTAL AND THEORETICAL STUDY OF NITRIC OXIDE FORMATION IN INTERNAL COMBUSTION ENGINES
George A. Lavoie, John B. Heywood, and James C. Keck Nov. 1969 39 p refs *Its* Fluid Mech. Lab. Publ. No. 69-10
Avail: CFSTI

The nonequilibrium formation of nitric oxide within the internal combustion engine cylinder is examined. A thermodynamic model which predicts the properties of the burnt and unburnt gases during the combustion process is developed. A set of reactions which govern the formation of nitric oxide is proposed, and rate equations for nitric oxide concentrations as a function of time in the post-flame gases are derived. The results of time-resolved measurements carried out on a CFR engine are described, where emitted light intensities at wavelengths selected to record radiation from the CO + O and NO + O continua were used to determine the nitric oxide concentration. The comparison between theoretical and experimental results for fuel-lean mixtures confirms that the important features of the model presented are correct. Author

N70-24368# Army Environmental Hygiene Agency, Edgewood Arsenal, Md.
ATMOSPHERIC SAMPLING STUDY OF NF ROCKET PROPELLANT, 26 MAY – 26 JUNE 1969
Howard A. Wiener, Robert P. Bartell, Thomas L. Hess, and Kenneth N. Ports 1969 38 p refs *Its* Air Pollution Engr. Study No. 99-003-69/70
(AD-699360) Avail: CFSTI CSCL 21/2

A field study was conducted to measure the concentration of and determine areas of exposure to total fluorides in the exhaust cloud of statically fired six pound motors utilizing a developmental Rohm and Haas NF propellant. Results of the study gave strong indications that only areas exposed to the visible exhaust would be contaminated by fluorides. The study results also indicated that all fluorides in the exhaust were predominantly in the gaseous state. Areas of greatest exhaust cloud total fluoride concentration were found to be at the approximate location where the cloud was initially formed. In the firing tests conducted, exposure to the cloud at any point within its path was determined to be less than one minute in all cases observed. It was estimated that areas at distances greater than 150 meters from the firing point of the six-pound motors would not be significantly exposed to fluorides from the exhaust. Author (TAB)

N70-24377# Aerospace Corp., El Segundo, Calif. Lab. Operations.
COMBUSTION RESIDUES FROM N2O4-MMH MOTORS Technical Report Jan. 1968 - Mar. 1969
Hideyo H. Takimoto and Genevieve C. Denault 15 Sep. 1969 29 p refs
(Contract F04701-69-C-0066)
(AD-698329; TR-0066(5210-10)-1; SAMSO-TR-69-373) Avail: CFSTI CSCL 21/2

Motor residues from the combustion of N2O4 and MMH were analyzed. Under steady-state and pulse-mode firings, the major constituents of the nonvolatile residues were found to be ammonium nitrate and MMH.HNO3, respectively. The latter material contained a heat-sensitive compound which triggered its decomposition at a lower temperature. The application of heat to MMH. HNO3 initially converted the salt to monomethylammonium nitrate. The infrared spectra and differential analysis curves for these materials are presented. Author (TAB)

N70-24426 Advisory Group for Aerospace Research and Development, Paris (France).
FUNDAMENTAL ASPECTS OF SOLID PROPELLANT ROCKETS
F. A. Williams, M. Barriere, and N. C. Huang Slough, England Technivision Services Oct. 1969 813 p refs
(AGARDograph-116) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

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1. AN INTRODUCTION TO SOLID PROPELLANT ROCKET MOTORS: GENERALITIES p 1 36 refs (See N70-24427 11-28)

2. NOZZLE FLOW AND CHARACTERISTIC PARAMETERS p 37 105 (See N70-24428 11-33)

3. PERFORMANCE OF SOLID PROPELLANTS p 107 184 refs (See N70-24429 11-27)

4. MOTOR OPERATION p 183 251 refs (See N70-24430 11-28)

5. EXPERIMENTAL ASPECTS OF STEADY-STATE COMBUSTION PHENOMENA p 253 331 refs (See N70-24431 11-27)

6. THEORIES OF STEADY-STATE SOLID PROPELLANT COMBUSTION p 333 393 refs (See N70-24432 11-27)

7. EROSIVE BURNING p 395 456 refs (See N70-24433 11-27)

8. IGNITION AND EXTINCTION OF SOLID PROPELLANTS p 457 – 553 refs (See N70-24434 11-27)

9. EXPERIMENTAL ASPECTS OF COMBUSTION INSTABILITY p 555 – 603 refs (See N70-24435 11-33)

10. THEORETICAL ANALYSES OF COMBUSTION INSTABILITY p 605-673 refs (See N70-24436 11-33)

11. MECHANICAL PROPERTIES AND STRESS ANALYSIS OF SOLID PROPELLANT GRAINS p 675 – 750 (See N70-24437 11-27)

12. THE FUTURE OF SOLID PROPELLANT ROCKETRY p 751 – 769 (See N70-24438 11-28)

N70-24429 Advisory Group for Aerospace Research and Development, Paris (France).
PERFORMANCE OF SOLID PROPELLANTS
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 107 – 184 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Mathematical calculations and experimental data are presented. The compositions of fuels and oxidizers are tabulated and the combustion products are identified. Theoretical calculations include those for the equilibrium composition of the combustion products as a function of pressure and temperature, thermodynamic properties for evaluation of propellant performance, and propellant constituents conducive to maximal performance. Laboratory and static firing test data are discussed, and the data are graphed. A brief comparison of theory and experiment is given. N.E.R.

N70-24431 Advisory Group for Aerospace Research and Development, Paris (France).
EXPERIMENTAL ASPECTS OF STEADY-STATE COMBUSTION PHENOMENA
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 253 – 331 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Experimental studies of heterogeneous propellant combustion are described, and the main results are presented as well as difficulties of interpretation. Three categories of experimental methods are discussed: those designed to determine the physico-chemical characteristics of each propellant constituent; those consisting of inventing and construction combustion models that resemble reality as closely as possible but are easier to analyze; and those containing the studies of combustion of real solid propellants. Experiments with homogeneous propellants are briefly discussed, using methods from the third category. Author

N70-24432 Advisory Group for Aerospace Research and Development, Paris (France).
THEORIES OF STEADY-STATE SOLID PROPELLANT COMBUSTION
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 333 – 393 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Basic time-dependent equations of aerothermochemistry are developed. After discussing some of the early models for combustion of double base propellants, the equations of aerothermochemistry are applied to the analysis of steady state combustion of homogeneous solid propellants. Adiabatic combustion is analyzed first and then the effects of heat losses are considered. Theories of the decomposition of ammonium nitrate and ammonium perchlorate are treated. Various mechanisms for combustion of composite solids are reviewed, and metal combustion is considered. Author

N70-24433 Advisory Group for Aerospace Research and Development, Paris (France).
EROSIVE BURNING
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 395-456 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The state of the knowledge on erosive burning of a propellant grain from published experimental results and theoretical models is summarized. Laboratory and engine measurement methods and results are discussed. Proposed semiempirical theories are reviewed, and the fundamentals of a more complete theory, based on the equations of aerothermochemistry, are established. Mathematical expressions are developed to describe the effect of erosion phenomena on the geometry of the central port. It is felt that there are unexplained technological and fundamental aspects to the problem. The phenomena are rendered more complex by the surface heterogeneity of composite propellants. N.E.N.

N70-24434 Advisory Group for Aerospace Research and Development, Paris (France).
IGNITION AND EXTINCTION OF SOLID PROPELLANTS
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 457-553 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

In the ignition study, the experimental results pertaining to the ignition of a propellant sample are analyzed. After a short review of the experimental techniques, a discussion is given of the influence on the ignition delay of the major parameters, such as the nature of the propellant and of the ambient gas, the pressure, and the sample temperature. Current theories of ignition are summarized. Ignition of an engine is studied and various successive processes, occuring during the period of pressure increase, are identified. Extinction by sudden depressurization and inhibitor injection are discussed. Author

N70-24437 Advisory Group for Aerospace Research and Development, Paris (France).
MECHANICAL PROPERTIES AND STRESS ANALYSIS OF SOLID PROPELLANT GRAINS
In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 675-750 refs (See N70-24426 11-27)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Structural aspects of solid propellant rocketry are discussed, stressing structural problems of solid propellant grains. Methods for describing the stress-strain relations of viscoelastic materials are given. Formulations for linear viscoelasticity, thermodynamic aspects of viscoelasticity, and the basis for describing nonlinear viscoelastic stress-strain relations are presented. Grain failure analysis is discussed, emphasizing the difficulties arising in failure studies, and describing crack formation and propagation. Viscoelastic stress analyses are given, primarily for infinitely long, hollow, tubular grains with circular ports. Author

N70-24571# Deutsche Forschungs- und Versuchsanstalt Fuer Luft- und Raumfahrt, Trauen (West Germany). Inst. fuer Strahlantriebe.
SURFACE REACTIONS IN SOLID PROPELLANTS
H. Selzer *In* AGARD Reactions Between Gases and Solids Feb. 1970 20 p refs (See N70-24551 11-06)
Avail: CFSTI

The state-of-the art of the combustion mechanism of AP-propellants is reviewed and some new experimental facts are given concerning the influence of lattice defects and condensed phase behaviour on the burning process. The findings demand a revision of the theoretical models to account for the lattice defect, for a change from fast to slow decomposition, and for reactivity spots. Author

N70-24574# Hercules, Inc., Magna, Utah.
SURVEY PAPER ON EROSION PRODUCED BY HIGH-SPEED TWO-PHASE FLOW IN SOLID PROPELLANT ROCKET MOTORS
Richard J. Zeamer *In* AGARD Reactions Between Gases and Solids Feb. 1970 19 p refs (See N70-24551 11-06)
Avail: CFSTI

Erosion produced by two-phase flow can be a serious problem in solid propellant rockets. The nongaseous phase originates from the powdered metals that are commonly added to solid propellants to increase their energy and density. As much as 40 percent of the exhaust flow can be in the form of liquid or solid particles. The combustion of metal in a solid propellant and the associated particle changes involve formation of metal agglomerates on the burning surface, ejection, ignition and then combustion in the gas stream producing tiny oxide smoke particles. These oxide droplets grow rapidly from diameters as small as 0.01 micron to around 0.2 micron because of collisions caused by Brownian motion. Continued growth is due to turbulence and acoustic agitation. Large gas velocity gradients in the nozzle region cause more frequent collisions and very rapid growth in particle size with average oxide particle diameters increasing five to ten times from nozzle entry to exit. In a solid propellant rocket motor the particles arriving at wall surfaces generally have releasable heat and chemical energy in addition to kinetic energy. Usually a large portion of this energy is transferred to the wall. Erosion by mechanical impact is negligible except in the nozzle exit cone and jet. Heating, together with high-temperature chemical reactions, is the principal cause of erosion in the nozzle entry and throat. Author

N70-24580# Centro Nazionale di Ricerca sulla Technologia della Propulsione e dei Materiali Relativi, Milan (Italy).
LINEAR REGRESSION VELOCITY OF AMMONIUM PERCHLORATE IN A COMBUSTIBLE GAS FLOW [LA VITESSE LINEAIRE DE REGRESSION DU PERCHLORATE D'AMMONIUM DANS UN ECOULEMENT GAZEUX COMBUSTIBLE]
Corrado Casci and Luigi De Luca *In* AGARD Reactions Between Gases and Solids Feb. 1970 30 p refs In FRENCH (See N70-24551 11-06)
Avail: CFSTI

The linear regression velocity in a cyclindrical sample composed of ammonium perchlorate in a gaseous combustible flow was experimentally determined. The nature and behavior of the catalyst in relation to the thermal decomposition of ammonium perchlorate considered. Results show that combustion was aided by the addition of light metals, and in particular by copper dioxide. Transl. by J.M.C.

N70-24841# Bureau of Mines, Washington, D.C.
STORAGE STABILITY OF AVIATION TURBINE FUELS: A RADIOTRACER TECHNIQUE FOR ESTIMATING COMPONENT CONTRIBUTION TO THERMALLY INDUCED DEPOSITS
Marvin L. Whisman, John W. Goetzinger, and Cecil C. Ward Dec. 1969 30 p refs
(AD-698742; BM-RI-7325) Avail: CFSTI CSCL 21/4

A radiotracer technique developed by the Bureau of Mines extends to the parts-per-billion range the sensitivity for determining contributors of deposits formed in stored and thermally stressed jet fuels. The method depends upon measuring radioactivity associated with thermally induced deposits from fuels containing one labeled compound. The technique was applied to 88 test blends, representing 12 fuels and nine carbon-14 labeled fuel constituents or fuel additives, or both. Data from results of these tests are

included in this report. With this radiotracer technique, the contribution of fuel components and additives to thermally induced deposits in a variety of fuel environments was estimated before and after storage. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-24081*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.

DEVELOPMENT OF AN SPS/DPS HYDROGEN SHROUDED CRYOGENIC HELIUM STORAGE SYSTEM Final Report

W. B. Bald 9 Oct. 1968 136 p refs

(Contract NAS9-7337)

(NASA-CR-109456; Publ-4019-68) Avail: CFSTI CSCL 21H

The development of a storage system sized to the approximate lunar module descent propulsion system requirements is described. A dewar design which incorporates two discrete radiation shields with the inner shield vapor cooled is shown to have minimum system weight potential for extended prelaunch and in-flight standby capabilities. The upgraded storage tank operates at 2000 psia. Remote monitoring and control of the unit is available by using the control panel supplied with the system. A limited amount of design analysis is included. Extensive thermal and dynamic testing was carried out on the completed tankage assembly to verify the basic design principles. This testing together with the graphed results is discussed. An updated log of the completed unit, and a discussion on the effect of shroud annulus geometry on the heat interception characteristics and standby capabilities are also included. Author

N70-24247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE AND STALL LIMITS OF AN AFTERBURNER-EQUIPPED TURBOFAN ENGINE WITH AND WITHOUT INLET FLOW DISTORTION

Roger A. Werner, Mahmood Abdelwahab, and Willis M. Braithwaite Washington Apr. 1970 34 p refs

(NASA-TM-X-1947; E-5352) Avail: CFSTI CSCL 21E

Performance and stall limits of a nonstandard TF30-P-1 turbo fan engine with uniform and distorted inlet flow are presented at a Reynolds number index of 0.5. Screens covering a 180 deg sector of the inlet were used to obtain the distortion. Results are presented in the form of compressor performance maps, stall limits, bypass ratio, stage group characteristics, distortion levels, and inlet profiles. Author

N70-24248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND TESTING OF A FLOX-METHANE THRUST CHAMBER ASSEMBLY

Donald A. Peterson, Jerry M. Winter, Albert J. Pavli, and Arthur M. Shinn, Jr. Washington Apr. 1970 33 p refs

(NASA-TM-X-1987; E-5311) Avail: CFSTI CSCL 21H

The results of a program to design and test fire a 600-pound-force (2670 N) FLOX-methane thrust chamber assembly are presented. A characteristic exhaust velocity efficiency of 98.4 percent of theoretical equilibrium was obtained at the design oxidant-fuel ratio of 5.5 and a chamber pressure of 400 psia (2756 kN/sq m). Calculations indicate that peak delivered vacuum specific impulse of 395 seconds would be obtained at an oxidant-fuel ratio of 5.3. Conventional ablative materials were determined to have limited life in the throat region at chamber pressures above 200 psia (1378 kN/sq m). Successful operation at 400 psia (2758 kN/sq m) was obtained with an ablative chamber and a throat insert of ATJS graphite with no erosion or cracking after a 200 second continuous firing. Author

N70-24427 Advisory Group for Aerospace Research and Development, Paris (France).

AN INTRODUCTION TO SOLID PROPELLANT ROCKET MOTORS: GENERALITIES

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 1–36 refs (See N70-24426 11-27)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (attn. Mr. A. L. Candido)

A brief description of solid propellant rocket engines, their classification, and the basis for interest in them are presented. The primary parts of the engines are identified as propellant grain, case, nozzle, and igniter. The classification scheme is based on fields of application, and consists of lower stages upper stages, satellite launchers, sounding rockets, auxiliary engines for specialized functions, assisted takeoff engines for aircraft, military applications, and diverse applications, and examples are given for each type. Quantitative aspects of mission performance evaluation and qualitative comparisons of solid propellant and liquid propellant rocket engines are discussed. N.E.N.

N70-24430 Advisory Group for Aerospace Research and Development, Paris (France).

MOTOR OPERATION

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 183–251 refs (See N70-24426 11-27)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A theory for predicting the steady state regime of solid propellant rocket engine operation is presented. Burning velocity laws are discussed, and the operation is studied of different engines with various grain shapes such as end-burning grains, cylindrical grains with central perforation and with radial combustion, and spherical grains. Dual composition grains are considered which allow improvement in the neutrality of burning or suppression of the pressure tail-off. The time evolution of the pressure is investigated, and the parameters that influence the evolution are indicated. The influence of the operating parameters on engine optimization is analyzed and the operation of small sublimation engines is studied. Author

N70-24438 Advisory Group for Aerospace Research and Development, Paris (France).

THE FUTURE OF SOLID PROPELLANT ROCKETRY

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 751–769 (See N70-24426 11-27)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (attn. Mr. A. L. Candido)

The possibilities for new research and technological advances are summarized. Details are discussed of newly emerging propellants, potential advances in fundamental research on the combustion of new propellants, new ideas on unsteady processes such as ignition and combustion instability, and technological developments of improved flexibility and control capabilities of solid propellent systems. Future uses of solid propellant rockets are also considered. Author

N70-24734# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).

DESIGN CRITERIA AND PRELIMINARY DEVELOPMENT WORK FOR A HIGH ENERGY PROPULSION MODULE (HETAM) [ENTWURFSKRITERIEN UND

ENTWICKLUNGSVORARBEITEN FUER EIN HOCHENERGETISCHES ANTRIEBSMODUL (HETAM)

D. E. Koelle, K. Bohnhoff, and E. Mueller. 1969. 28 p. refs. In GERMAN. Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969.
(RF-112-O) Avail: CFSTI

A description is given of the propulsion module HetAM (Hochenergetisches Antriebsmodul) which uses fluorohydrogen propellants and can be used with the Europa 3 launch vehicle. ESRO

N70-24802*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STATIC PERFORMANCE OF AN AUXILIARY INLET EJECTOR NOZZLE USING AN AFTERBURNING TURBOJET GAS GENERATOR

Richard R. Burley and Ali H. Mansour. Washington, Apr. 1970. 47 p. refs.
(NASA-TM-X-1999; E-5459) Avail: CFSTI CSCL 21E

Three ejector nozzle configurations which were appropriate for operation at takeoff, transonic acceleration, and supersonic cruise flight conditions were tested over a range of nozzle pressure ratios from 2 to 32. Corrected secondary weight flow was varied from 0.02 to 0.08 and primary exhaust gas temperatures varied between 1651 and 3420 R (917 and 1900 K). The data are presented in terms of pumping characteristics and nozzle efficiency. Typical pressure and temperature profiles along the ejector internal wall surface are also shown. Author

N70-24892*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMPUTER PROGRAM FOR QUICKLY ANALYZING ELECTRIC PROPULSION MISSIONS

Alfred C. Mascy. Washington, Apr. 1970. 49 p. refs.
(NASA-TM-X-2004; A-3482) Avail: CFSTI CSCL 21C

A computer program is described that is capable of determining the performance and system requirements of electrically propelled spacecraft in combination with specific launch vehicles and high-thrust upper stages. The formulation of the logic and optimization techniques are described as well as the functional relationships that define the characteristics of the high- and low-thrust systems. The several output formats, including a plot option, are illustrated, and complete descriptions of all input and output parameters and a program listing in Fortran 4 are given. The input is simplified by use of colloquial variables. Example problems are provided which depict the usage of the various options available to the user. These options include: planet orbiters or flybys, launch to parking orbit or direct to escape, built in stable of launch vehicles or specified by input, high-or low-thrust Earth departure, high- or low-thrust planet arrival, optimum or constrained power, optimum or constrained thrust time, optimum or constrained hyperbolic velocities, optimum (alpha = f(P) or constrained propulsion system specific mass, all-ballistic high-thrust comparisons, and three output formats, including graphical. The program is quite accurate in simulating entire missions and can define their requirements very quickly due to the short execution times, which range from 0.1 second to 0.5 second, on an IBM 360-50 (0.05 to 0.25 on IBM 7094, 0.02 to 0.1 on IBM 360-75) depending on the option selected. Convergence is guaranteed. Author

N70-25078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMBUSTION CHAMBER HYDRAULIC ANALYSIS

Ya. P. Storozhuk et al. 18 Aug. 1969. 40 p. Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. i Proektno-Konstrukt. Kotloturbinnyi Inst. (Leningrad), no. 75, 1967 p 181-208
(AD-698998; FTD-HT-23-1319-68) Avail: CFSTI CSCL 21/5

A proposed method for the hydraulic calculation of combustion chambers is based on the fact that the chamber resistance is composed of local resistances created under isothermal conditions, i.e., purely hydraulic resistance and that resulting from combustion. The flow of jets in the chamber is considered to be a flow in parallel ducts. Losses in any duct consist of pressure losses at the individual sections in the duct. The study consists of two parts: (1) a study of the resistance of a combustion chamber and its elements, and (2) the hydraulic calculation method. The considered parameters, formulas, and calculation results are presented in tabulated form. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-23988*# Wisconsin Univ., Madison. Space Physics Group.

SPACE PHYSICS GROUP QUARTERLY STATUS REPORT

Mar. 1970. 13 p. refs.
(Contract NAS5-11068; GRANT NGL-50-002-044)
(NASA-CR-109455) Avail: CFSTI CSCL 03B

The results of the calibration work on the prototype gamma ray detector for OSO-B are briefly summarized. The measures intensity and galactic distribution of gamma rays from the galactic anticenter are explained by two assumptions: (1) The interstellar gas density is as implied by 21 cm hydrogen line emission studies. (2) The cosmic ray intensity if the galactic disc at distances greater than 10 kpc from the center is the same as it is near the solar system. Other investigations include: rocket X-ray, OSO-A X-ray, S-150 X-ray, galactic atomic hydrogen, and deuterium composition of the solar wind. F.O.S.

N70-24140# California Univ., Berkeley. Space Sciences Lab.

SOLAR EMISSION AND ACTIVITY IN THE FREQUENCY REGION 18 TO 38 GIGACYCLES

Mohammed El Raey, S. Silver, and W. J. Welch. Dec. 1969. 15 p. refs. *Its* Space Sciences Lab. Series 10, Issue 55
(Contract Nonr-222(54))
(AD-698264) Avail: CFSTI CSCL 3/2

The spectral distribution of solar radiation and the characteristics of solar activity have been studied intensively and may be considered well known in the megacycle region of the spectrum. Attention has turned recently to higher frequencies and it is being recognized that there is much to be learned about the sun by studying the emission and activity in the centimeter and millimeter wave region. The paper is a report of recent observations made over the frequency band 18 to Gc/sec and the correlation of the observations with optical data on sunspots, plages, and flares. One set of observations was carried out at the time of the flare event of April 25, 1969. Author (TAB)

N70-24182# Cornell Univ., Ithaca, N.Y. Dept. of Physics.

THE PHYSICS OF COSMIC X-RAY, GAMMA-RAY AND PARTICLE SOURCES

K. Greisen. Aug. 1969. 189 p. refs.
(Grant AF AFOSR-255-67)
(AD-699251, CLNS-77; AFOSR-70-0020TR) Avail: CFSTI CSCL 3/2

Contents: Sources of high-energy particles; ESP (Energetic Solar Particles); Discrete sources remote from the sun; Interactions in the interstellar medium; Origin of the primary electrons; Cosmic gamma rays; and Cosmic x-rays. TAB

N70-24751*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COSMIC RAY DIFFUSION AND THE 'LEAKAGE LIFETIME' APPROXIMATION: AN INVESTIGATION OF ITS VALIDITY BY THE EIGENFUNCTION EXPANSION TECHNIQUE

Frank C. Jones Apr. 1970 65 p refs Submitted for publication
(NASA-TM-X-63885; X-641-70-129) Avail: CFSTI CSCL 04A

The diffusion of cosmic ray particles in a finite volume of space with a simultaneous diffusion and/or transport in energy is considered. The solution of the appropriate differential equation may be expressed as an expansion in eigenfunctions of the differential operator. If one approximates the solution by keeping only the lowest or fundamental eigenfunction one obtains the common leakage lifetime approximation. In some situations this approximation can be justified but in others (e.g., synchrotron or inverse Compton losses) it cannot. The reason for the failure in this case can be seen from the point of view of the expansion. The solution of the general case of Fermi acceleration, synchrotron losses, and energy fluctuation acting together is also obtained by this method. Author

N70-24785*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ORIGIN OF GALACTIC GAMMA-RAYS. PART 2
T. P. Stecher and F. W. Stecker Apr. 1970 9 p refs Submitted for publication
(NASA-TM-X-63886; X-641-70-130) Avail: CFSTI CSCL 04A

The revised measurements of galactic gamma ray intensities as measured by OSO-3 are given, and are accounted for by the pion-decay process in the galactic disk and by a combination of this process and Compton interactions with an intense infrared radiation field in the region of the galactic center. This interpretation is in harmony with present understanding of the interstellar medium and obviates the need to invoke more speculative source models. It also indicates the potential use of gamma ray telescopes in mapping the interstellar medium. Author

N70-24797# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 221 2 Feb. 1970 p 91-140 refs (See N70-24792 11-34)
Avail: CFSTI

The launchings of Cosmos 314, 315, 316, and 317, and Intercosmos 2 are described. The construction of new factories for the aerospace industries is discussed. Physical and technical principles of space research are reviewed, as well as the goals of the Soviet space program. Ionospheric research and cosmogeology are briefly mentioned. Abstracts on a wide spectrum of upper atmosphere and space research are included. J.A.M.

N70-24976# Weapons Research Establishment, Adelaide (Australia).
CHROMOSPHERIC FLARE ENHANCEMENTS IN THE EUV AND THEIR RELATIONSHIP WITH SOLAR ABUNDANCES
B. C. Bowers [1969] 10 p refs
(WRE-TM-HSA-194) Avail: CFSTI

Observations of increases in the solar output at wavelengths in the extreme ultraviolet during flare activity are compared with currently accepted values of metallic abundances in the solar chromosphere. It is found that, with some exceptions, good correlation exists; reasons are offered for the exceptions. The conclusion reached is that spectral enhancements appear to be related to solar abundances, but further observations are essential. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-24185*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VARIATION OF PARAMETERS AND THE LONG-TERM BEHAVIOR OF PLANETARY ORBITERS. PART 1: THEORY
Bernard Kaufman Feb. 1970 40 p refs
(NASA-TM-X-63870; X-551-70-15) Avail: CFSTI CSCL 22C

The theory developed to determine the behavior of planetary orbiters under the perturbative influences of the oblateness of the central body, the presence of the sun, and atmospheric drag is discussed. The significant contribution is the treatment of the third body which includes the medium-period as well as the long-period terms of the disturbing function in a system of singly-averaged equations. The variation of the elements is then expressed along with the effects of drag and oblateness in a set of equations to yield a time history of the orbit. These equations are easily adapted to an electronic computer. In test runs this program was shown to be extremely fast and accurate to within short-period terms when compared with a complete numerical integration of the equations of motion. Author

N70-24209# Ohio River Div. Labs., Cincinnati.
LUNAR SOIL SIMULANT STUDY, PHASE B. PART 1: OUTGASSING CHARACTERISTICS Final Report
J. H. Hubbard and E. S. Gall Dec. 1969 45 p refs Sponsored by Army
(AD-699426; ORDL-TR-4-58) Avail: CFSTI CSCL 3/2

The work describes an investigation of the outgassing characteristics of diabase rock crushed to a gradation equivalent to a fine sand. Materials were heated in air to various temperatures and for several exposure periods and were then placed in a high vacuum chamber for pump down. The variation of pressure with time was plotted and the effect of nitrogen overlays between successive pump downs were evaluated. The one-dimension diffusion equation was solved to indicate the way in which pressure varies with depth. Author (TAB)

N70-24265# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CELESTIAL MECHANICS: BASIC PROBLEMS AND METHODS, VOLUME 1
G. N. Duboshin 22 Aug. 1969 255 p refs Transl. into ENGLISH from the Russian
(AD-699159; FTD-HT-23-956-68-Vol-1) Avail: CFSTI CSCL 3/0

The document represents the first comprehensive Soviet study of celestial mechanics published in over twenty years. It is part of a series released in 1961 dealing with the theory of gravitation, celestial mechanics and the analytical and qualitative methods of the latter. This present volume on celestial mechanics contains the following chapters: The equations of Lagrange and Hamilton; Differential equations of translational motion of celestial bodies; The differential equations of translational and rotational motion of celestial bodies; Integration of the differential equations of unperturbed motion; The investigation of unperturbed motion. TAB

N70-24286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CELESTIAL MECHANICS: BASIC PROBLEMS AND METHODS, VOLUME 2
G. N. Duboshin 22 Aug. 1969 229 p refs Transl. into ENGLISH from the Russian
(AD-699160; FTD-HT-23-956-68-Vol-2) Avail: CFSTI CSCL 3/0

The volume contains the following chapter headings: Series used for unperturbed elliptic motion; Fundamental methods of the theory of perturbed motion; The general theory of perturbations; Canonical equations of the theory of perturbations; A historical and bibliographical sketch of the development of celestial mechanics (Appendix). TAB

N70-24301*# Massachusetts Inst. of Tech., Cambridge.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY FOURTH QUARTERLY PROGRESS REPORT, 1 NOVEMBER 1969 - 31 JANUARY 1970
28 Jan. 1970 89 p refs
(Contract NAS9-9024)
(NASA-CR-108344) Avail: CFSTI CSCL 22C

The necessary conditions for the optimality of the filter free parameter were derived for the case in which no measurements were incorporated during the time of interest. The numerical results are given for programming the optimal solution for a circular and an elliptical nominal orbit. The linear filter weight for incorporating a position - type measurement was postulated to be of a specified form, involving a free parameter micron. The case was expanded to include the incorporation of velocity dependent measurements. A study and model of various gravitational anomalies was given with an end toward better orbit prediction capabilities. Author

N70-24302*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
[NAVIGATION AND GUIDANCE PROGRAMMING FOR LONG DURATION ORBITAL MISSIONS] Summary Report
[1970] 17 p refs
(Contract NAS9-9024)
(NASA-CR-108345) Avail: CFSTI CSCL 22C

New techniques are described for the navigation and guidance of space vehicles in order to maintain a prescribed orbit for long duration orbital missions. The scope of the study is not only a description of the techniques, but also the computer program for performing the navigation and guidance calculations required by each technique. Author

N70-24308*# Massachusetts Inst. of Tech., Cambridge.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY THIRD QUARTERLY PROGRESS REPORT, 1 AUGUST - 31 OCTOBER 1969
Oct. 1969 54 p refs
(Contract NAS9-9024)
(NASA-CR-108343; QPR-3) Avail: CFSTI CSCL 22C

A satellite state vector is defined which consists of the position deviation and two velocity deviation components, expressed in a rotating coordinate system, plus the deviation from the nominal energy of the satellite. The inclusion of the energy deviation in the state limited the growth rate of the total energy of the satellite, reflecting the fact that the satellite-planet system is conservative. A technique is presented for determining the scalar measurement geometry vector for the above mentioned state when the corresponding measurement geometry vector for the state vector consisting of all six position and velocity variations, expressed in inertial coordinates, is known. This technique is valid when the scalar measurement is a function of the satellite position only. Author

N70-24335# Liege Univ. (Belgium). Inst. d'Astrophysique.
INTERMEDIATE-RESOLUTION STUDY OF THE UV SPECTRUM OF HOT STARS BETWEEN 1050 AND 3200 A [ETUDE A RESOLUTION MOYENNE DU SPECTRE ULTRAVIOLET DES ETOILES CHAUDES ENTRE 1050 ET 3200 A]
L. Houziaux, C. Jamar, and A. Monfils Paris ESRO May 1969 31 p refs In FRENCH; ENGLISH summary
(ESRO-SN-102) Avail: CFSTI

The S-116 experiment is devoted to the study of UV spectra from celestial bodies. The system proposed by the authors allows a resolution of 1.8 A to be achieved with a relatively coarse pointing accuracy (0.5 arc minute). This system enables spectra of stars having a visual magnetude 5 to 6 to be obtained, with a precision of 2% for B stars. The pointing accuracy requirements permit the use of an intermediate-size satellite, possibly of the TD class. ESRO

N70-24344# Yale Univ. Observatory, New Haven, Conn.
OPERATION OF A RESEARCH CENTER FOR CELESTIAL MECHANICS Final Technical Report, 1 Oct. 1968 - 30 Sep. 1969
G. M. Clemence 16 Dec. 1969 5 p refs
(Grant AF-AFOSR-397-67)
(AD-698848; AFOSR-69-3094TR) Avail: CFSTI CSCL 3/3

Celestial mechanics. Reports, Jupiter Planet, Perturbation theory, Orbital trajectories, Moon, Mars Planet, Stars, Satellites Artificial, Resonance, Relativity theory, Astrophysics. TAB

N70-24347*# California Univ., Berkeley. Space Sciences Lab.
SCIENTIFIC RATIONALE FOR APOLLO LUNAR (ORBITAL) ELECTROMAGNETIC SOUNDER EXPERIMENT Final Technical Report
Stanley H. Ward Mar. 1970 112 p refs *Its* Ser. 11, Issue 22
(Contract NAS2-4996)
(NASA-CR-73435) Avail: CFSTI CSCL 22A

A Lunar Electromagnetic Sounder experiment is tentatively scheduled to be part of the science payload in the mission of Apollo 19. In basic concept, the experiment requires transmission of electromagnetic waves from the spacecraft in orbit, reflection of these waves from the moon, and subsequent reception of the waves at the spacecraft. The complex ratio of received signal to transmitted signal provides information which may be interpreted in terms of the three-dimensional distributions of electrical conductivity, dielectric constant, and magnetic permeability in the lunar interior. Author

N70-24485# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
SOLAR X-RAY OBSERVATION OF FORBIDDEN LINES IN THE HELIUM ISOELECTRONIC SEQUENCE Research Report Jun. 1967 - Jul. 1969
A. B. C. Walker, Jr. and H. R. Rugge 15 Nov. 1969 37 p refs
(Contract E04701-69-C-0066)
(AD-699261; TR-0066(9260-02)-4; SAMSO-TR-69-399) Avail: CFSTI CSCL 3/2

The 1s sup 2 singlet S sub 0 - 1s2p singlet P sub 1 resonance and the 1s sup 2 singlet S sub 0 - 1s2p triplet P sub 1 intercombination lines in the helium-like ions of carbon, oxygen, neon, and magnesium observed in the solar corona are accompanied by strong, longer wavelength satellites. Gabriel and Jordan identify these wavelength satellites as due to single-photon decay of the 1s2s triplet S sub 1 level, and point out that the intensity ratio of the triplet P sub 1 and triplet S sub 1 lines is a sensitive function of electron density at typical coronal densities. The report gives the relative intensities of each of the three lines and discusses the coronal densities that they predict. Author (TAB)

N70-24486# RAND Corp., Santa Monica, Calif.
LONGITUDINAL STATION KEEPING OF NEARLY GEOSTATIONARY SATELLITES
N. C. Ostrander Nov. 1969 65 p refs
(Contract F44620-67-C-0045)
(AD-698738; RM-6166-PR) Avail: CFSTI CSCL 22/3

An examination of the gravitational effects of the sun, moon, and triaxial earth upon the longitudinal motion of near-synchronous equatorial satellites. Accurate station-keeping of a nominally geosynchronous satellite requires the application of control forces to offset these gravitational effects. This study extends earlier work, complementing latitude motion studies with a corresponding examination of longitude and radial motions. Control system activity, which includes average annual pulse and frequency of pulse application, is related to station-keeping accuracy. Radial and longitudinal perturbations are calculated. The results are particularly relevant to the station-keeping problems imposed by a growing number of satellites in synchronous near-equatorial orbits. The

present investigation is restricted to satellites limited to small excursions by periodic applications of impulsive control forces. Author (TAB)

N70-24538*# Massachusetts Inst. of Tech., Cambridge.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY SECOND QUARTERLY REPORT, 1 MAY - 31 JULY 1969
Jul. 1969 73 p
(Contract NAS9-9024)
(NASA-CR-108342) Avail: CFSTI CSCL 22C

Complete and concise proof is presented for a filter scheme representing unknown error correlations which result from poorly known driving forces. Since the filter scheme is overly conversative for the orbital navigation problem, general developments of the relevant equations are given in which the attracting body is rotating at constant angular velocity. Necessary conditions are derived to minimize arbitrary linear combination elements of the terminal covariance matrix of estimation errors through quadratic function minimization of the estimation error at any selected terminaime. This method is used to solve two point boundary value problems. Precision extrapolation of the vehicle along its orbit is obtained by using the initial position and velocity vectors of the osculating conic as state variables for the case describing vehicle motion in the case where the path is not a conic. The fact that the external gravitational field of an arbitrary body may be represented by a surface layer of mass and mass dipoles is as a new approach to modelling the gravitational field of a body. G.G.

N70-24548 Rensselaer Polytechnic Inst., Troy, N.Y.
SENSITIVITY GUIDANCE FOR ENTRY INTO AN UNCERTAIN MARTIAN ATMOSPHERE
Paul Jon Cefola (Ph.D. Thesis) 1969 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-17904

Martian entry guidance problem is found to be complicated by the great uncertainty in the present definition of the Martian atmospheric parameters. A guidance scheme that will produce a reference terminal condition whatever the actual atmosphere encountered on Mars entry is suggested. The approach is analytical. Sensitivity analysis is applied to the entry dynamics in order to compute the effects of both density parameter deviations and control changes. After the atmospheric parameters are tracked, the control is determined on-board by using the sensitivity coefficients previously compiled. Control updating is provided by introducing a new sensitivity equation which reduces the on-board computation since all the required terminal sensitivity coefficients are now produced by the solution of one equation. Dissert. Abstr.

N70-24586# Observatoire de Paris (France).
RESULTS ABOUT MAJOR PLANETS, PART 1 Final Scientific Report, 1 Jul. 1967 - 30 Jun. 1969
Audouin Dollfus, J. H. Focas, K. A. Hameen-Anttila (Oulu Univ.), and R. Prinz (Bayerische Volkssternwarte, Munich) Aug. 1969 60 p refs
(Contract F61052-68-C-0001)
(AD-699229; AFCRL-69-0530-Pt-1) Avail: CFSTI CSCL 3/2

Contents: New optical measurements of the diameters of Jupiter, Saturn, Uranus and Neptune; The atmospheric activity of the planet Jupiter; and The activity of Jupiters atmospheric belts between 1905 and 1963. TAB

N70-24587# Observatoire de Paris (France).
RESULTS ABOUT MAJOR PLANETS, PART 2 Final Scientific Report, 1 Jul. 1967 - 30 Jun. 1969
Audouin Dollfus, J. H. Focas, K. A. Hameen-Anttila (Oulu Univ.), and R. Prinz (Bayerische Volkssternwarte, Munich) Aug. 1969 56 p refs
(Contract F61052-68-C-0001)
(AD-699230; AFCRL-69-0530-Pt-2) Avail: CFSTI CSCL 3/2

The paper contains two reports: Optical properties and density of the rings of Saturn viewed edgewise in 1966, and a model of Saturns rings. TAB

N70-24622# Wroclaw Univ. (Poland). Astronomical Observatory.
CATALOG OF MAGNITUDE DIFFERENCES OF THE COMPONENTS OF 2379 DOUBLE AND MULTIPLE STARS [CATALOGUE DES DIFFERENCES DE MAGNITUDE DES COMPOSANTES DE 2379 ETOILES DOUBLES ET MULTIPLES]
Stefan Wierzbinski 1969 220 p In FRENCH *Its* Mat., Fs. Astronomia No. 94
(Contrib-16) Avail: CFSTI

A catalog was prepared to indicate the magnitude difference in the components of orbital and closely paired stars. Visual estimation and photometric measurements were made of 786 pairs of stars. Systematic corrections of photometric measurements are tabulated. Individual corrections were reduced in every observation to the photometric system. Transl. by J.M.C.

N70-24636*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, 1 Oct. 1969 - 1 Jan. 1970
Jan. 1970 18 p refs
(NASA Order R-09-040-001)
(NASA-CR-109399) Avail: CFSTI CSCL 03B

Status summaries for seven project tasks included: background, supporting, and coordinating activities for dispersion of scientific and engineering information with emphasis on Apollo lunar surface and returned lunar sample experiments; drilling and friction studies in ultrahigh vacuum; rock deformation in compression tests using a simulated lunar environment; comparison of fabric with velocity symmetry patterns in various rocks; effect of moisture and reduced pressure on thermal fragmentation of rocks; design and construction of high vacuum facility; vane shear device which tested simulated lunar powders, e.g. basalt; cell and insulation system for quantitative analysis of oxygen yield in electrowinning experiments silicate-fluoride mixtures. S.L.

N70-24654*# Ward (Stanley H.), Oakland, Calif.
ELECTROMAGNETIC EXPLORATION OF THE MOON
Stanley H. Ward Moffett Field, Calif. NASA Sep. 1968 563 p
(Contract NAS2-4720)
(NASA-CR-73378) Avail: CFSTI HC $10.00/MF $0.65 CSCL 03B

Elements of electromagnetic theory relevant to lunar subsurface exploration are presented based on a literature review and critical evaluation. Electrical properties of matter are summarized, together with known approximated lunar parameters. Possible electromagnetic systems are identified, analyzed, and interrelated in an exploration sequence. Electrical conduction, dielectric constant, and magnetic properties of rocks are discussed. Lunar electrical models are theorized. Geophysical methods for measuring electrical parameters are also assessed. S.L.

N70-24706# Colorado Univ., Boulder
ON LARGE-SCALE SOLAR CONVECTION
Robert P. Davies-Jones and Peter A. Gilman Nov. 1969 50 p refs
(Contract F19628-67-C-0304)
(AD-699243; AFCRL-69-0491; SR-8) Avail: CFSTI CSCL 3/2

The paper examines the effects of rotation about a vertical axis on thermal convection with a simple model in which an inviscid, incompressible fluid of zero thermal conductivity and electrical resistivity is contained in a thin annulus of rectangular cross-section. The initial steady state assumed is one of no motion relative to the rotating frame with constant (unstable) vertical temperature gradient and uniform toroidal magnetic field. Small periodic disturbances are then introduced and the linearized perturbation

equations solved. The second order mean circulations and magnetic fields that are forced by non-zero Reynolds and thermal stresses and magnetic field transports are also determined. The solutions have several properties which are relevant to large-scale solar phenomena if giant long-lived convection cells exist on the sun. Author (TAB)

N70-24768*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIATION PRESSURE EFFECTS ON THE ACCELERATION OF HIGH ALTITUDE BALLOON SATELLITES

David E. Smith and Kenneth H. Fea (London Univ.) Mar. 1970 24 p refs Submitted for publication

(NASA-TM-X-63881; X-550-70-92) Avail: CFSTI CSCL 22C

Previous studies of the orbital accelerations of the high altitude balloon satellites, Pageos and Dash 2 have shown the existence of perturbations that appear to be related to solar radiation pressure but of unknown mechanism. The normal method of computing the radiation perturbations assumes the effective shape of the spacecraft to be spherical but in the present paper an investigation is undertaken to assess the perturbations that may arise when the satellite has an ellipsoidal shape and the radiation scattered by the spacecraft is no longer symmetric about the line joining the satellite and the sun. Consideration is given to both diffuse and specular reflection. The study indicates that a slowly precessing rotation axis might explain the anomalous accelerations found in the earlier studies. Author

N70-24793# Joint Publications Research Service, Washington, D.C.

ASTRONOMY

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 221 2 Feb. 1970 p 1-5 refs (See N70-24792 11-34)

Avail: CFSTI

Astrophysical and cosmological problems are reviewed, including electromagnetic radiation observations in the infrared and radio spectral ranges. The significance of atmospheric radiocarbon measurements is reiterated. The Naran high mountain station's solar research is briefly discussed, as well as the operations of the Sun-Earth Council. The birth of stars and spectral classification problems are also mentioned. J.A.M.

N70-24823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN INTERCOMPARISON OF NAVY TRANET DOPPLER DATA AND OPTICAL DATA FROM THE GEOS-1 SATELLITE

Russell W. Agreen and James G. Marsh Dec. 1969 69 p refs

(NASA-TM-X-63876; X-552-69-539) Avail: CFSTI CSCL 22C

Orbital solutions for the GEOS-I satellite obtained from U.S. Navy TRANET Doppler data and those from optical flash data recorded by the NASA Space Tracking and Data Acquisition Network and Smithsonian Astrophysical Observatory systems were intercompared. The orbital arcs used for this study were two days in length and were in the period July 9 through August 7, 1966. RMS of fits for the orbital solutions were on the order of 1.9 seconds of arc for the optical solutions and 2.7 cm/sec for the Doppler solutions. Comparisons of the corresponding optical and Doppler orbital ephemerides showed total RMS position differences ranging from 20 to 40 meters. Biases in the base frequency value of the Doppler data were solved for; consistent biases in the base frequency around 9 cm/sec + or - 3 cm/sec were found. Author

N70-24826# University Coll., London (England). Mullard Space Science Lab.

PRELIMINARY DESIGN OF A COSMIC X-RAY SURVEY EXPERIMENT Conference Proceedings

P. J. Bowen and W. M. Glencross, eds. Oct. 1969 204 p refs Proc. of the NATO Advan. Study Inst. in Space Expt. Design, London, 25 Aug.-12 Sep. 1969; sponsored by NATO

Avail: CFSTI

CONTENTS:

1. X-RAY ASTRONOMY J. L. Culhane p 1-13 refs (See N70-24827 11-30)

2. X-RAY TELESCOPE OPTICS D. J. Schroeder (Beloit Coll.) p 14-27 refs (See N70-24828 11-14)

3. X-RAY DETECTORS FOR GALACTIC ASTRONOMY FROM SATELLITES R. J. Davis (Smithsonian Astrophys. Obs.) p 28-34 refs (See N70-24829 11-14)

4. CALIBRATION OF X-RAY PHOTOMULTIPLIERS A. F. Timothy and J. G. Timothy p 35-43 refs (See N70-24830 11-14)

5. ELECTRONIC DESIGN FOR SATELLITE APPLICATIONS J. A. Bowles p 44-50 (See N70-24831 11-09)

6. SPACE EXPERIMENT POWER SUPPLIES F. W. Kramer (Ges. fur Weltraumforsch. m.b.H) p 51-54 ref (See N70-24832 11-03)

7. MECHANICAL DESIGN OF SPACE EXPERIMENTS: A SHORT REVIEW A. Hammerschlag (Tech. Phys. Dienst TNO-TH, Delft) p 55-60 (See N70-24833 11-32)

8. SPACE EXPERIMENT THERMAL DESIGN M. Schach (NASA, Goddard Space Flight Center) p 61-71 (See N70-24834 11-33)

9. ON-BOARD DATA PROCESSING A. C. Brinkman (Lab. voor Riumteonderzoek) p 72-75 refs (See N70-24835 11-08)

10. THE ANALYSIS OF SATELLITE DATA W. J. Raitt p 76-82 (See N70-24836 11-08)

11. PRELIMINARY DESIGN STUDY OF A COSMIC X-RAY SURVEY EXPERIMENT: RESULTS P. M. Addison, P. G. Arnold, B. E. Bonnelycke, I. J. Cochrane, P. M. Jonasson et al p 83-127 refs (See N70-24837 11-30)

N70-24827# University Coll., London (England). Mullard Space Science Lab.

X-RAY ASTRONOMY

J. L. Culhane *In its* Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 1-13 refs (See N70-24826 11-30)

Avail: CFSTI

Present and future developments in the field of X-ray astronomy are reviewed. The observation of sources, source spectra, variability and the diffuse component are discussed. It is concluded that larger telescopes on orbiting spacecraft should lead to important results concerning the nature of the Universe. ESRO

N70-24837# University Coll., London (England). Mullard Space Science Lab.

PRELIMINARY DESIGN STUDY OF A COSMIC X-RAY SURVEY EXPERIMENT

In its Prelim. Design Study of a Cosmic X-ray Survey Expt. Oct. 1969 p 83-119 refs (See N70-24826 11-30)

Avail: CFSTI

This preliminary design study of a cosmic X-ray survey experiment was prepared by students at a summer school. The X-ray survey was intended to be conducted from an orbiting solar observatory and the following aspects are presented: aims of the experiment, spacecraft constraints, X-ray telescopes and detectors, electronic equipment design and mechanical and thermal design. The analogue circuit design, digital circuitry and power supplies are treated in detail. ESRO

N70-24849# Observatoire de Paris (France).

POLARIMETRIC PROPERTIES OF THE LUNAR SURFACE AND ITS INTERPRETATION. PART 1: OBSERVATIONS Final Scientific Report

Audouin Dollfus and Edward Bowell Jun. 1969 65 p refs

(Contract AF 61(052)-914)

(AD-699241; AFCRL-69-0529) Avail: CFSTI CSCL 3/2

The paper reports on observations and analysis of polarimetric

properties of the lunar surface. During the contract two new photoelectric polarimeters were developed, one for infrared and one for ultraviolet light. Part I of the study contains the observational work and is subdivided into two parts. The first part dealt with the polarization characteristics of 14 lunar regions of 65 seconds covering the wavelength range from 0.327 to 1.05 microns. Polarization curves have been obtained for all of these regions. A second set of observations is the determination of the maximum degree of polarization in orange light, of 142 regions, most of which are less than 5 seconds in diameter. The analysis of the measurements of maximum degree of polarization and the normal albedo yields a mathematical interrelation which very probably holds for all lunar terrains. A final portion of this study was the determination of a new lunar normal albedo scale based on measurements provided by nine different sources and the preparation of a catalog of normal albedos of 67 small lunar regions. Part II of the report discusses the application of the polarimetric techniques to the quantitative evaluation of physical properties of small regions on the lunar surface. Author (TAB)

N70-24888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF RECEIVER BANDWIDTH ON LUNAR OCCULTATION OBSERVATIONS: NARROW SYMMETRIC PASSBANDS
T. Krishnan Washington Apr. 1970 23 p refs
(NASA-TN-D-5679) Avail: CFSTI CSCL 03B

A general expression is derived for the effect of receiver bandwidth on lunar occultation observations, the phenomenon being considered equivalent to diffraction at a straight edge. The expression is applied to derive the parameters defining effective beam due to bandwidth alone for five symmetrical and narrow passbands of common shape. It is shown that the half-power effective beamwidth in seconds of arc (for the mean moon-earth distance) varies between 6.2 and 7.2 times the square root of the absolute half-power bandwidth in wavelength expressed in meters. Sensitivity and beam shape evaluations indicate that in radio astronomy applications, given a desired resolution, the single-tuned passband is optimal. When the beam shape is well behaved it is unnecessary to preconvolve the theoretical restoring function with a Gaussian, as is usually done. Author

N70-24891*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVE MOTION OF TWO PARTICLES IN ELLIPTIC ORBITS
E. R. Lancaster Apr. 1970 10 p refs Submitted for publication
(NASA-TM-X-63884; X-643-70-120) Avail: CFSTI CSCL 22C

Contrary to the past presentations of approximate solutions to the problem of the relative motion of two particles in elliptic orbits in an inverse-square central force field, an exact solution is derived to this problem, subject to no restrictions. The results have applications to problems of rendezvous, nonlinear error analysis, station keeping, targeting, surveillance, and satellite clustering. Author

N70-24981# Montpellier Univ. (France). Dept. de Physique Mathematique.
CROSS SECTIONS IN AN EXPANDING UNIVERSE 1
D. Gerbal (Obs. de Meudon) and Remi Hakim Jan. 1970 17 p refs
(PM/70/1) Avail: CFSTI

Arguments are presented to exhibit the dependence of cross sections on the scale factor characterizing the time evolution of an isotropic homogeneous universe. Author

N70-25031*# California Univ., Berkeley. Space Sciences Lab.
THEORETICAL CALCULATION OF THE ELECTROMAGNETIC RESPONSE OF A RADIALLY LAYERED MODEL MOON Technical Report
B. D. Fuller and S. H. Ward [1969] 30 p refs
(Contract NAS2-4996)
(NASA-CR-73436) Avail: CFSTI CSCL 03B

To inquire how layering would affect the concept of the electromagnetic behavior of the lunar sphere and to what extent the possibility of layering should be considered in the design of an experiment to determine the electrical properties of the lunar interior a model is used of a multi-layered sphere excited by a plane electromagnetic field. The layers are concentric and each layer is assumed to have constant electrical parameters chosen according to best estimates. Author

N70-25093*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MINIMUM DELTA 5, THREE-IMPULSE TRANSFER ONTO A TRANS-MARS ASYMPTOTIC VELOCITY VECTOR
William C. Bean Washington Apr. 1970 24 p refs
(NASA-TN-D-5757; MSC-S-231) Avail: CFSTI CSCL 22C

For the numerical study that is presented, the primary objective was to obtain a set of minimum velocity vector three-impulse maneuvers from a specified circular Earth parking orbit onto a constrained asymptotic velocity vector that is characteristic of Mars. A computer program based on an accelerated gradient method for function minimization was used. Twenty cases were examined in which the four parametric values (0 deg, 2 deg, 4 deg, and 6 deg for the out-of-plane angle of the asymptotic velocity vector were chosen with the idea that launch window considerations dictate a small maximum tolerable error in parking-orbit orientation at departure, and in which the five parametric values (8, 12, 24, 48, and 72 hours) for the period of the elliptical first transfer conic were chosen arbitrarily to result in realistically small total flight times for a maneuver. Author

N70-25122*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRAJECTORIES OF EXPLORERS 33, 34 AND 35, JULY 1966 – APRIL 1969
K. W. Behannon, K. H. Schatten, D. H. Fairchild, and N. F. Ness Feb. 1970 47 p refs
(NASA-TM-X-63846; X-692-70-64) Avail: CFSTI CSCL 22C

Solar elliptic plane projection of the orbits for Explorer 33, 34, and 35 are presented. Included summaries are: (1) Explorer 33 from launch, and near earth studies on the night magnetosphere, (2) Explorer 34 orbits, and apogee and perigee times are tabulated, and (3) Explorer 35 lunar orbits. F.O.S.

N70-25133*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif.
THE LONG-TERM MOTION OF ARTIFICIAL PLANETARY SATELLITES
[1969] 121 p refs
(Contract NAS5-10782)
(NASA-CR-109498) Avail: CFSTI CSCL 22C

The described work concerns the orbit evolution problem for strongly perturbed artificial satellites of Mercury, Venus, Earth and Mars. The unifying feature is that the principal effects on the orbit elements come from the gravitational fields(s) of the Sun (and Earth's Moon) and the coupling of those effects with pericenter, node, and inclination variations caused by the non-sphericity of the central planet. Semianalytic techniques are presented that describe the long-term motion of artificial satellites disturbed by a third body, oblateness of the central planet, and atmospheric drag. The techniques are applied to the orbit evolution problem for satellites of each of the four inner planets, and a four-planet survey outlines the effects of the major perturbations for satellites of each planet. The primary analytic results of this report are modifications to an existing method to include the effects of the disturbing body's eccentric orbit. The principal numerical results are comparisons of pericenter histories given by the method with histories obtained by numerical integration of the actual equations of motion. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-23946*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A SOLAR ELECTRIC MULTI-MISSION SPACECRAFT, VOLUME 1A Final Technical Report
15 Mar. 1970 302 p refs Prepared for JPL Revised
(Contracts NAS7-100; JPL-952394)
(NASA-CR-109433; TRW-09451-6001-R0-03-Vol-1A-Rev) Avail: CFSTI CSCL 22B

Results of the preliminary design and feasibility study of a solar-powered electric propulsion spacecraft capable of performing multiple interplanetary missions are presented. The mission of principal interest is a survey (flythrough) mission of the asteroid belt. Alternate missions were studied in less detail. They included flyby of an asteroid, flyby of Jupiter, and a survey mission out-of-the-ecliptic plane at high orbital inclinations. Launch vehicles considered in the study include the Atlas/Burner 2, the Atlas-Centaur, and Titan 3C. Mission analyses were performed to define basic mission and system design parameters for the solar-electric multimission spacecraft (SEMM). The objective was to identify a single spacecraft design concept for all of the missions specified. Simplified mission models and approximate trajectory computations were used to obtain first order approximations covering the wide range of alternatives for the various missions. Some spacecraft performance characteristics differ slightly from the values selected initially. Author

N70-23947*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A SOLAR ELECTRIC MULTI-MISSION SPACECRAFT, VOLUME 1B Final Technical Report
15 Mar. 1970 391 p refs Prepared for JPL Revised
(Contracts NAS7-100; JPL-952394)
(NASA-CR-109432; TRW-09451-6001-R0-03-Vol-1B-Rev) Avail: CFSTI CSCL 22B

System and subsystem design implementation are described for the baseline SEMM spacecraft configuration. These include: the propulsion system, the power subsystem, the electric distribution subsystem, attitude control, communications, data handling, structure and mechanisms, thermal control, and central computer and sequencer. Reliability goals and objectives are outlined. Spacecraft flight operation, spacecraft configuration alternatives, and system tradeoffs are discussed. M.H.E.

N70-23948*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A SOLAR ELECTRIC MULTI-MISSION SPACECRAFT, VOLUME 2 Final Technical Report
15 Mar. 1970 50 p Prepared for JPL Revised
(Contracts NAS7-100; JPL-952394)
(NASA-CR-109434; TRW-09451-6001-R0-03-Vol-2-Rev) Avail: CFSTI CSCL 22B

The planning and cost estimating portion is conducted to gather data which are necessary to evaluate the SEMM spacecraft design. Costly or risky design approaches were eliminated; the ultimate design was then costed, and bread development and management plans were prepared. The data define development effort, schedules, facilities required, and costs and are presented so that they can be combined with launch vehicle and mission support data to compare chemical and solar-electric missions. The data also make it possible to compare the SEMM spacecraft with other spacecraft designs and provide input for NASA resource planning. A baseline program plan using a conventional approach was prepared, and then alternate plans were developed by modifying the baseline plan. Corresponding cost estimates were made and the alternatives studied to find where cost advantages lay. At the total spacecraft system level, development costs would differ only because of differing numbers of solar arrays. Ranking of the configurations during manufacturing, assembly, integration, and test also was influenced only by the number of solar arrays. No differences in difficulty of operation were apparent in launch and mission operations. Author

N70-23949*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A SOLAR ELECTRIC MULTI-MISSION SPACECRAFT Final Summary Technical Report
15 Mar. 1970 139 p Prepared for JPL Revised
(Contracts NAS7-100; JPL-952394)
(NASA-CR-109435; TRW-09451-6001-R0-03-Rev) Avail: CFSTI CSCL 22B

A baseline solar-electric propulsion spacecraft design is defined, as well as preliminary program planning and cost data for its development, to provide a point of departure for a broad spectrum of space exploration missions. The cost and weight effectiveness of solar-electric propulsion is demonstrated in four sample missions, but the results can be readily extended to other missions of great scientific interest such as outer planet flyby and orbiter missions, comet intercepts and Mercury orbiter missions, all of which demand high propulsive energy. In fact, the more energetic the mission, the more cost-effective, in general, will be the use of solar-electric propulsion. The optimum staging concept developed here offers particular advantages. The sequence of missions which would use the multi-mission solar-electric spacecraft most effectively, once it is developed and flight-proven, is not necessarily the one which is postulated in this study. There is, in fact, considerable merit in the suggestions by some space mission planners that a very high energy mission such as the out-of-ecliptic survey should be attempted as one of the earliest applications of the multi-mission spacecraft. Author

N70-24228# Aerospace Corp., El Segundo, Calif. Office for Development Planning.
OPTIMAL RESOURCE ALLOCATIONS FOR SPACE LOGISTICS MISSIONS
Joseph Delfico 31 Dec. 1969 25 p refs
(Contract F04701-69-C-0066)
(AD-698747; SAMSO-TR-69-376; TR-0066(5529)-1) Avail: CFSTI CSCL 22/2

The problem of transporting space hardware from earth to orbit utilizing reusable logistics systems is addressed with the objective of determining the payload capacity of the vehicle which will minimize total system resource expenditures for a given annual orbital delivery requirement. A simple method for determining the minimum cost parameters of the transportation system is presented utilizing the Lagrangian multipler technique. Trends and sensitivities of the resultant solutions are discussed. Author (TAB)

N70-24259# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FROM THE HISTORY OF AVIATION AND COSMONAUTICS: COLLECTION OF ARTICLES [IZ ISTORII AVIATSII I KOSMONAVTIKI]
V. A. Popov et al 22 Aug. 1969 304 p refs Transl. into ENGLISH from Russian publ.
(AD-696044; FTD-HT-23-1233-68) Avail: CFSTI CSCL 1/2

Contents: Biographies, Rocket plane flights, Jet propulsion study groups, Space carrier rockets, Gliding, Aviation and cosmonautics, Ramjet engines, Rocket technology, Conquest of the stratosphere, and Hydroaviation. TAB

N70-24300*# TRW Systems Group, Redondo Beach, Calif.
APOLLO MISSION 11, TRAJECTORY RECONSTRUCTION AND POSTFLIGHT ANALYSIS, VOLUME 1
16 Mar. 1970 137 p refs

(Contract NAS9-8166)
(NASA-CR-108349; TRW-11176-H508-R0-00) Avail: CFSTI CSCL 22C

The objective of the postflight analysis task was, in general, to generate trajectory parameters and data for the command and service modules (CSM) and LM from S-IVB/CSM separation to the end of mission. As in the Apollo missions 9 and 10, a preliminary trajectory was generated from the best available RTCC vectors. The bulk of the postflight analysis effort was then concentrated on reconstruction of the two periods of flight from LM/CSM undocking to LM touchdown (descent phase) and from LM ascent to LM/CSM docking (rendezvous). The RTCC vectors used to generate the preliminary NAT (NASA Apollo Trajectory) are summarized. Most of the lunar trajectories were generated using RTCC SS2 (inclination constrained) solution vectors rather than SS1 (no a priori) solution vectors. Unlike the Apollo 10 SS2 vectors which were constrained to the pre-LOI1, rev 18, and rev 29 planes, the Apollo 11 SS2 vectors were constrained on a rev to rev basis. Each SS2 vector contained two revs of data and was constrained to the SS1 solution plane of one of these two revs (exceptions existed at maneuvers). This technique prevented the accumulation of a large error in the out-of-plane component of position. Author

N70-24403# European Space Research and Technology Center, Noordwijk (Netherlands).
THE HEOS-1 PROGRAMME. VOLUME 1: DESCRIPTION AND DEVELOPMENT EXPERIENCE
G. H. Booth, comp. Jul. 1969 54 p
(ESRO-TR-3(ESTEC)) Avail: CFSTI

The HEOS-1 programme report is divided into two volumes dealing, respectively, with the satellite description and development experience, and the assessment of performance in orbit. The history of the project, the scientific aims of the programme and briefly those of the individual experiments, the orbit and launch conditions, the satellite design itself and the experience gained during the development of the spacecraft and finally the operations following the launch are described. Two chapters deal respectively with the Delta launch vehicle and the organisation of the project. Only minor technical conclusions are drawn with regard to the development experience. The major overall conclusion is that it has been shown that a truly international space-probe programme can be accomplished on a strict time schedule and within reasonable cost limits. The main reason for this was integrated teamwork on the part of contractor and customer, which promoted the ready exchange of ideas and information. ESRO

N70-24410# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, OCTOBER 1969
R. D. Eberst 29 Jan. 1970 31 p
(ROE-STS-94) Avail: CFSTI

Stopwatch observations made at stations during October 1969 are listed in satellite launch order and in time order for each satellite. Various subtotals are given. Author (ESRO)

N70-24730# Entwicklungsring Nord, Bremen (West Germany).
CONCEPTION AND LATEST DEVELOPMENT OF TD1-A, THE LARGEST EUROPEAN SATELLITE WITH A SCIENTIFIC PAYLOAD [KONZEPTION UND BISHERIGE ENTWICKLUNG FUER TD1-A, DEN GROESSTEN EUROPAEISCHEN SATELLITEN MIT WISSENSCHAFTLICHER NUTZLAST]
K.-D. Berge 1969 41 p In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The development of the ESRO TD1-A satellite, and its configuration and experiments are described. The structure and function of its subsystems such as the positioning control, telecommunication, and power supply systems are outlined, and the heat budget is discussed. The management methods involved in the project are also described. ESRO

N70-24737# Contraves Corp., Zurich (Switzerland).
HEAT BALANCE OF ESRO-1 SATELLITE IN ITS ORBIT [DAS TEMPERATURVERHALTEN DES ESRO-1 AUF SEINER UMLAUFBAHN]
A. Jordi 1969 19 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The research satellite ESRO-1 was launched on 3 October 1968 and its polar orbit affects the satellite heat balance. Temperature measurements on board the satellite are described, and the results are evaluated and compared with preflight tests. ESRO

N70-24744# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, SEPTEMBER 1969
R. D. Eberst 10 Dec. 1969 25 p
(ROE-STS-93) Avail: CFSTI

Stopwatch observations made at stations connected with the satellite tracking section during September 1969 are listed in satellite launch order and in time order for each satellite. Various sub totals are given. Author (ESRO)

N70-25085*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APOLLO 10 (AS-505) APOLLO SATURN 5 SPACE VEHICLE Technical Information Summary
1 May 1969 94 p
(NASA-TM-X-62846; S/E-ASTR-S-69-24) Avail: CFSTI CSCL 22B

The document presents a brief and concise description of the AS-505 Apollo Saturn Space Vehicle. Where necessary, for clarification, additional related information has been included. The information presented herein, by text and sketches, describes launch preparation activities, launch facilities, and the space vehicle. This information permits the reader to follow the space vehicle sequence of events beginning a few hours prior to liftoff to its journey into space. Author

N70-25098*# Little (Arthur D.), Inc., Cambridge, Mass.
DESIGN AND FABRICATION OF SHADOW SHIELD SYSTEMS FOR THERMAL PROTECTION OF CRYOGENIC PROPELLANTS Final Report
27 Nov. 1969 53 p refs
(Contract NAS3-10292)
(NASA-CR-72595; ADL-C-69507) Avail: CFSTI CSCL 22B

A system of shadow shields for the long-term thermal protection of a liquid hydrogen propellant tank was designed and fabricated. The design was based on the results of a previous analytical study in which several conceptual designs were evaluated for a spaceborne upper-stage configuration in which the shadow shields were located between a sun-oriented, 10-foot-diameter payload and liquid hydrogen tank. This report describes the design and fabrication of a scaled-down, 4-1/2-foot-diameter shadow shield system which will be used in ground-based experiments to determine the effectiveness of a shadow shield system in reducing propellant boil-off. Author

N70-25104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Electronics and Control Div.
A CONCEPTUAL DESIGN OF THE SPACE SHUTTLE INTEGRATED AVIONICS SYSTEM
Fred E. Digesu, ed. 3 Feb. 1970 289 p refs
(NASA-TM-X-53987) Avail: CFSTI CSCL 22B

The status of an investigation to define an integrated avionics system for the Space Shuttle is presented. The system concept

depicted for the integrated approach, based on subsystem requirements established early in the study, meets the mission requirements outlined in Shuttle Task Group reports and is compatible with the significant features of the vehicle configurations resulting from several 1969 contractor design studies. Included as part of the integrated avionics system is all Shuttle equipment that utilizes electronics in performance of the various functions required to accomplish the Space Shuttle mission. The individual subsystems are defined in varying degrees of detail and all data will be subject to change as the design work continues. Sufficient data are presented, however, to identify the significant physical characteristics, important performance values, functional block diagrams, and preliminary hardware selection for each avionics subsystem. Author

N70-25156# European Space Research Organization, Paris (France).
PROGRESS IN OPERATIONAL PROGRAMME
In its ESRO/ELDO Bull., No. 8 Jan. 1970 p 17-21 In ENGLISH and FRENCH (See N70-25153 11-34)
Avail: CFSTI

The ESRO-Ib (Boreas) satellite results furnished scientific data comparable with those from ESRO 1. It reviews the continuing operations of ESRO 2 and HEOS 1 satellites, and gives a full account of the sounding rocket campaigns of October and November 1969. The state of program definition for the HEOS A-2, TD-1, ESRO 4, COS-B, and the geostationary magnetospheric satellite projects are assessed. ESRO

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-24001# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 1, NO. 8
1969 56 p refs
(AD-698507) Avail: CFSTI CSCL 20/11

Contents: Digital simulation of dynamic systems; News briefs; Short courses-abstracts from the current literature; Program, 40th symposium on shock and vibration; Book reviews; Calendar of events. TAB

N70-24065# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF THE DYNAMIC STABILITY OF SHALLOW SHELLS
N. K. Alekseeva 20 May 1969 9 p refs Transl. into ENGLISH from Prikl. Mekh., v. 5, no. 12, 1969 p 60-68
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The problem of dynamic stability for three boundary conditions considering geometric nonlinear factors and longitudinal inertial forces are solved using a variational method by computers. The equations of motion in displacements are utilized to solve for these boundary conditions: simple support, hinge support, and longitudinal displacement. Conclusions are: (1) The influence of nonlinear inertia is noticeable under shell support conditions assuring the greatest mobility of its edges. (2) Longitudinal vibrations, as the shell thickness increases, result in growth of the transverse vibration amplitude, and to the extension of the boundaries of dynamic instability. F.O.S.

N70-24056# Columbia Univ., New York.
FUNDAMENTAL STUDIES OF FRACTURE Final Report, 7 May 1965 - 6 May 1969
Maxwell Gensamer and James C. M. Li Dec. 1969 11 p refs
(Contract DA-31-124-ARO(D)-382)
(AD-698474) Avail: CFSTI CSCL 20/11

The investigation of fracture focused on elucidating the mechanisms by which strain becomes so concentrated that the work of deformation, limited to a small volume becomes little. The research concerned primarily with engineering materials consisted of the following phases: (1) A theoretical study of the elastic contribution to the surface energy controlling final separation of the material embrittled by plastic deformation. (2) An experimental study of how to reveal the plastic zone and measure its size in materials of interest. (3) A study of strain hardening, which controls the plastic zone size, by studying the effects of prior strain on the operation of latent slip systems. (4) A study of strain hardening by calculating the stress at a point due to pile-up complete dislocation loops. (5) A study of the process of fracture in fatigue, both experimental by optical and electron microscopy, and theoretical by applying dislocation dynamics. (6) An experimental and theoretical study of plastic zone strain distribution, controlling fracture toughness, and propagation velocity controlling crack speed, in iron and an iron-silicon alloy. (7) A similar study of brass, involving stacking-fault energy as a variable. (8) A study of creep, relating to the slow growth of cracks preceding rapid crack propagation, by applying the theory of thermally and stress activated rate processes to dislocation movements. Author (TAB)

N70-24109# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
EQUATIONS FOR HIGH SUPERSONIC FLUTTER OF CROPPED DELTA SURFACES
D. J. Johns Jan. 1970 21 p refs
(TT-7002) Avail: CFSTI

The flutter equations were derived for a spigot-mounted cropped delta surface using linear piston theory. The four modes assumed are vertical translation; linear spanwise roll; rotation of the spigot; parabolic chordwise bending. Detailed parametric studies were not made but the equations were manipulated to show their application to two particular binary flutter problems. Author

N70-24160# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 1, NO. 4
1969 25 p refs
(AD-698506) Avail: CFSTI CSCL 20/11

The planning and evaluation of tests are reviewed, including (1) purpose of the test, (2) availability and limitation of any instruments used, (3) availability of the system itself, and (4) the way in which the data is to be processed and presented. Improvements in piezoelectric devices and strain gages are discussed. Well known system combinations for data acquisition and modern electronic techniques were used to improve information quality from tests. A preview of the 11th Midwestern Mechanics Conference is presented, along with abstracts from current literature on analysis and design methods, excitation, phenomenology, experimentation, components, and systems for shock and vibration studies. J.A.M.

N70-24223*# Wyle Labs., Inc., Huntsville, Ala.
A STUDY OF THE VIBRATION RESPONSES OF SHELLS AND PLATES TO FLUCTUATING PRESSURE ENVIRONMENTS
D. J. Bozich and R. W. White Washington NASA Mar. 1970 164 p refs
(Contract NAS9-7484)
(NASA-CR-1515; WR-69-19) Avail: CFSTI CSCL 20K

Effects of modal cross-correlations on the spatial distributions of vibration amplitudes are investigated for a damped, uniform

beam having localized excitation. Using a computerized modal analysis method, analytical estimates of the space-average mean-square acceleration response spectra were determined for a variety of uniform cylindrical shells and flat plates exposed to ducted progressive acoustic wave fields, a reverberant acoustic field, and boundary layer turbulence. Several approximations of the series response equation are introduced in order to show how special situations can be treated by elementary methods. A comparison between the modal analysis and statistical energy methods is presented for shell response to reverberant acoustic excitation. Author

N70-24260# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.

GENERAL SOLUTION OF AN INELASTIC BEAM-COLUMN PROBLEM

W. F. Chen Sep. 1969 95 p refs

(Contract N00024-69-C-5381)

(AD-699507; Rept-331.5) Avail: CFSTI CSCL 13/13

Analytical solutions that describe the elastic-plastic behavior of a beam-column loaded at the ends and the mid-span are presented. Much work has been done on the elastic solution, so the current effort is to extend this work to the inelastic range. Difficulties associated with the analysis are outlined, and the method of attack in overcoming these difficulties is described. The theoretical analysis of the six different cases which correspond to different stages of plastification within the beam-column is discussed. Interaction curves for combinations of axial force and lateral load that can be safely supported by the beam-column of rectangular and wide-flange cross sections are presented. The beam-column with an initial curvature is also discussed. Author (TAB)

N70-24287# Naval Scientific and Technical Information Centre, Orpington (England).

DIFFERENCES IN THE LOADABILITY OF HEAVY PLATES RESULTING FROM ANISOTROPY

K. Born and W. Lauprecht Sep. 1969 30 p refs Transl. into ENGLISH Stahl 'U.'Eisen (West Germany), v. 88, no. 9, 1968 p 429–439 *Its* Trans. No. 2026

(AD-698659; NSTIC/23991/69) Avail: CFSTI CSCL 13/13

Heavy plates of normalized and heat-treated structural steels were tested for their mechanical properties, primarily on the basis of tensility and notch impact resistivity, the test pieces being taken longitudinally and transversely to the rolling direction and vertically to the rolling surface. The experimentation embraced a heavy plate of rust and acid proof austenitic steel, partially forged, multilayer submerged-arc and manual electric welds as well as forged ingots from an experimental melt. The last-named steels were primarily aimed at discovering the cause of anisotropy. The results showed that the main effect on the variation in the respective mechanical properties of samples taken in the three test directions was from the manganese sulphide exudation present in technical steels. This effect was expressed particularly in the results from aluminiferous fine-grain steels. Agglomerations of manganese silicate in coarse-grain steels may also be a contributory factor. Local anisotropy may also result from exogenous impurities. Despite low sulphur content and good supersonic results, samples from steels whose aluminum content exceeded 0.02% produced unsatisfactory values for plasticity and notch resistivity vertical to the rolling surface. Author (TAB)

N70-24318*# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.

PLASTICITY AND THE CRACK OPENING DISPLACEMENT IN SHELLS

F. Erdogan and M. Ratwani Apr. 1970 39 p refs

(Grant NGR-39-007-011)

(NASA-CR-66924) Avail: CFSTI CSCL 20K

The plastic deformations and the crack opening displacement, delta, in cylindrical shells with an axial or circumferential crack and spherical shells with a meridional crack are considered. It is assumed that outside the perturbation zone of the crack, the shell is subjected to uniform membrane loads perpendicular to the crack. The plastic strip model is used to calculate the plastic zone size. The crack opening displacement is calculated as the crack surface displacement at the crack tips by using the conventional superposition technique. In cylindrical shells with an axial crack, the crack surface displacement perpendicular to the shell surface (i.e., the bulging) is also evaluated. The results are applied to a set of existing experimental data on the fracture of cylindrical shells. The tentative conclusion is that in dealing with the fracture of thin walled structures, among various fracture models delta = constant appears to be the most satisfactory criterion. Author

N70-24320*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

A STUDY OF THE ACCURACY OF A FLIGHT-HEATING SIMULATION AND ITS EFFECT ON LOAD MEASUREMENT

Roger A. Fields Washington Apr. 1970 27 p refs

(NASA-TN-D-5741; H-597) Avail: CFSTI CSCL 20K

A series of laboratory heating tests simulating the flight heating on an X-15 horizontal stabilizer was conducted. The initial test simulated, as nearly as reasonably possible, the temperatures that were recorded during an X-15 flight to a Mach number of 4.63. Ten additional heating tests were conducted during which inaccuracies were introduced into the flight heating simulation. The objective of these tests was to establish the effect of the inaccuracies on the strain gage responses and ensuing load measurements. Strain gage-bridge responses from all tests were reviewed and compared with those calculated for a stabilizer load of 6000 pounds force (26,700 newtons). The tests were shown to be useful for selecting bridges for use in load-equation derivations and for selecting the equations that yield load measurements with the lowest overall error. Author

N70-24342# Bettis Atomic Power Lab., Pittsburgh, Pa.

COMPUTER PROGRAM BL47 FOR PLOTTING PLANE STRUCTURES

C. M. Friedrich and J. J. Cullens Feb. 1969 42 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-783) Avail: CFSTI

BL47 is a plotting routine designed for plane structures that are to undergo stress analysis. Points and lines are input in various parametric forms, and curved segments are drawn between given points along the given lines. The program may be used as a drafting tool to construct engineering drawings. Author (NSA)

N70-24351# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

COMPARISON OF DIFFERENT METHODS OF ASSESSING THE FREE OSCILLATORY CHARACTERISTICS OF AEROELASTIC SYSTEMS

A. Jocelyn Lawrence and P. Jackson London Aeron. Res. Council 1970 77 p refs Supersedes RAE-TR-68296; ARC-31379

(ARC-CP-1084; RAE-TR-68296; ARC-31379) Copyright. Avail: CFSTI

Different approximate methods of determining the eigenvalues of the integro-differential matrix equation of a simple aeroelastic system are compared. It is shown that methods which use an approximate second order differential matrix equation with constant coefficients can give large errors in the values of complex eigenvalues. An improved solution method using a finite series approximation to the indicial aerodynamics yielded in some cases an additional complex eigenvalue. Author (ESRO)

N70-24378 California Univ., Berkeley.

INCREMENTAL ANALYSIS OF LARGE DEFORMATIONS IN MECHANICS OF SOLIDS WITH APPLICATIONS TO

AXISYMMETRIC SHELLS OF REVOLUTION
Saeed Yaghmai (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-18992

A general incremental variational method for the analysis of geometrically and physically non-linear problems in continuum mechanics is developed. This variational method is applicable to any type of material properties. In particular, non-linear constitutive laws for elastic, and elastic-plastic materials are considered. Starting from the basic principles in continuum mechanics, such as the invariance requirements and the thermodynamic laws, general incremental constitutive equations have been derived for non-linear elastic materials. For the elastic-plastic materials an incremental constitutive law is considered where deformations are infinitesimal but rotations are finite. The method has been specialized and applied to the analysis of large deflections of elastic-plastic axisymmetrically deformed shells of revolution. Dissert. Abstr.

N70-24384*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TORSIONAL VIBRATION ANALYSIS OF SATURN VEHICLES
Larry Kiefling and Frank Bugg 27 Feb. 1970 36 p refs
(NASA-TM-X-53990) Avail: CFSTI CSCL 20K

Methods for finding the torsional vibration modes for either a beam-like vehicle, such as Saturn V, or a multibeam vehicle, such as Saturn IB, are developed. The singel beam analysis is a Stodola iteration method. The Saturn IB vehicle is mathematically modeled as a system of beams and connecting members. The modes of the vehicle are composed of the superimposed components of normal beam modes plus rigid body motion. A comparison is made with dynamic test data. The calculated frequencies differed from the experimental values by an average of eight percent for the cases compared. Author

N70-24386# Argonne National Lab., Ill. Reactor Engineering Div.
EVALUATION OF POTENTIAL TUBE VIBRATION IN EBR-2 STEAM SUPERHEATERS AND EVAPORATORS AT FULL POWER
Martin W. Wambsganss, Jr. Nov. 1969 43 p refs
(Contract W-31-109-eng-38)
(ANL-7600) Avail: CFSTI

An analytical evaluation of the EBR 2 steam superheaters and evaporators is performed to determine the potential for detrimental flow-induced tube vibrations at current operating power (45 MWt) and at design power (62.5 MWt). Based upon state-of-the-art technology, the evaluation includes analyses and discussions of resonant vibration induced by cross flow; hydroelastic instabilities due to parallel flow; baffle design and orientation in the flow field; and tube-baffle impact and its effect on vibrational characteristics and response of the tubes. Although some insight is gained into the mechanisms involved, limitations of the technology and lack of experiments preclude any conclusions regarding reliability of the EBR 2 steam superheaters and evaporators. Author

N70-24413*# Chrysler Corp., Huntsville, Ala. Space Div.
COMPARATIVE ANALYSIS OF ACOUSTIC TESTING TECHNIQUES, EXHIBIT A Final Report
W. J. Gruner Jul. 1969 309 p refs
(Contract NAS8-21425)
(NASA-CR-102561; HSM-R30-69) Avail: CFSTI CSCL 20K

Results of an analytical and empirical research program directed toward improving laboratory simulation of space vehicle system acoustic fields. State-of-the-art methods for calculation of vibratory response of spacecraft structural members to acoustic fields are presented in terms of modal analyses, statistical energy techniques and coincidence effects. Empirically derived vibro-acoustic transfer functions for four panel configurations are compared to predicted results. Results of the analyses are utilized to derive recommended methods and procedures for simulating the vibratory response of structures and components to acoustic fields in various types of laboratory facilities. Results of radiation damping, mass loading and exposed surface area analyses and experiments are also detailed. Author

N70-24418 Colorado Univ., Boulder.
OPTIMUM DAMPING IN NONLINEAR SYSTEMS SUBJECT TO SHOCK LOAD
John Dustin Kemper (Ph.D. Thesis) 1969 283 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 69-19552

An investigation of the behavior of systems with nonlinear elements subjected to shock loads, especially with reference to optimum nonlinear damping is reported. Two cases of single-degree-of-freedom systems are examined, one subjected to velocity shock and the other to an explosive-type distrubance; the first represents landing impact, while the second represents a ground acceleration shock delivered to sensitive equipment mounted in aircraft, ships, or underground control stations. Response curves are plotted for all systems for various combinations of the nonlinear and excitation parameters. Combinations of parameters are then selected which give optimum responses in accordance with a series of different optimization criteria. In the final phase a computer program is developed which automatically searches for the optimum damping function for any given nonlinear restoring force function and allowable acceleration. All results are presented in dimensionless form, normalized with respect to the excitation. Dissert. Abstr.

N70-24445 Oregon State Univ., Corvallis.
DYNAMIC ANALYSIS OF THREE-DIMENSIONAL FRAMES
Roger Edwin School (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19913

The response of three-dimensional frames subjected to an arbitrary dynamic force is studied. The method of mode superposition is used to obtain the frame response solution. Two different modeling systems are used to idealize the frame. These are the discrete mass system and the continuous mass system. For an example frame configuration, the eigenvalues and eigenvectors for four different discrete mass models are investigated. These four models represent varying degrees of discrete mass modeling sophistication for the frame. In addition, the eigenvalues are investigated by considering a continuous mass model of the example frame. The time-history response for the discrete mass model is determined using both a numerical procedure with a digital computer, and by using an analog computer. Listings of the digital computer programs are provided. The analog computer circuitry used in the solution is also given. Dissert. Abstr.

N70-24460# Weidlinger (Paul) Consultants, New York.
INVESTIGATION OF GROUND SHOCK EFFECTS IN NONLINEAR HYSTERETIC MEDIA. REPORT 3: A NOTE ON THE PLANE WAVES OF PRESSURE AND SHEAR IN A HALF-SPACE OF HYSTERETIC MATERIAL
Alva Matthews and Hans H. Bleich Jan. 1969 36 p refs
(Contract DACA39-67-C-0048)
(AD-699411; AEWES-CR-S-68-1-3) Avail: CFSTI CSCL 20/11

The problem of one dimensional plane wave propagation is considered in isotropic, nonlinear, hysteretic materials. Solutions for surface loads of step pressure and/or shear, in cases of loading or unloading are studied, and the presence of shocks and regions of continuous stress change are discussed. The mathematical models used are a generalization of conventional elastic models. The elastic moduli are assumed to be functions of a stress invariant, and the shear moduli are functions of both the same stress invariant and the stress deviators. Different expressions for the

elastic moduli and the shear moduli are used during loading and unloading, leading to energy loss through hysteresis.
Author (TAB)

N70-24467# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
FIBER-MATRIX INTERACTION IN A COMPOSITE MATERIAL
A. Levy Feb. 1970 30 p refs
(RM-488) Avail: CFSTI

The theory for a concentric cylinder model is further developed and applied to a two-phase cylindrically laminated model of a repeating element of a fibrous composite. Results are presented on the basis of a first-order approximation that allows a specification of average end loadings on individual phases and thus permits investigation of a discontinuous fiber embedded in a matrix where the end loadings across the fiber and matrix are different. The results of a discontinuous fiber embedded in a matrix are sufficiently realistic to reveal important features of the displacement and triaxial stress fields associated with fiber discontinuity, for example the present analysis predicts a higher interfacial shear stress concentration near the fiber end and a more rapid axial decay of stresses than found from earlier works. Author

N70-24515 California Univ., Berkeley.
A CLASS OF CYLINDRICAL COSSERAT SURFACE
Michael Leon Wenner (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18989

The constitutive equations of a linearized Cosserat plate theory which is intended to imitate the behavior of a three-dimensional plate of variable thickness are considered. The initial director of the Cosserat surface is of variable intensity. The constitutive equations, which are invariant under a suitable isotropy group, are obtained by considerations of the corresponding three-dimensional plate. A method of deducing explicit constitutive equations is described and applied to a prismatic plate, i.e., one whose thickness varied with only one of the Cartesian coordinates on its middle surface. The reduction for a plate of uniform thickness is indicated. Constitutive equations for the prismatic plate are also obtained by a systematic reduction of the classical linearized equations of three-dimensional continuum mechanics, and are discussed in special cases.
Dissert. Abstr.

N70-24518 State Univ. of New York At Buffalo.
PRINCIPLES OF DISCRETIZATION OF CONTINUOUS STRUCTURES
Barna A. Szabo (Ph.D. Thesis) 1969 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-20518

The Finite Element Method of structural analysis is derived from the equations of equilibrium and state by Galerkin's method of error distribution. It is shown that all energy theorems, which were previously considered by exponents of the Finite Element Method and others as first principles, can also be derived from the equilibrium equations as limiting cases of Galerkin's method. An 18 degree-of-freedom plate element and a sequence of plane elastic finite elements satisfying the requirements of uniqueness of interpolation, symmetry with respect to coordinate transformation, completeness in the sense of the Weier-stress theorem and feasibility of development are defined. An iteration procedure which will permit satisfaction of the biharmonic and compatibility equations within the domains of plate and plane elastic elements, respectively, is outlined. Finally, a brief discussion is given on the finite element analysis of plates, loaded by lateral and membrane forces.
Dissert. Abstr.

N70-24520# Catholic Univ. of America, Washington, D.C.
ASYMMETRIC BUCKLING OF SPHERICAL CAPS WITH ASYMMETRICAL IMPERFECTIONS
Robert Kao and Nicholas Perrone Feb. 1970 31 p refs
(Grant NSF GK-2802)
(Rept-16) Avail: Issuing Activity

The problem of the buckling of thin walled spherical shells was solved using the nonlinear relaxation technique to treat the finite difference representation of the differential equations governing cap response. For clamped spherical caps designated by lambda = 6, buckling loads are somewhat lower for the same imperfection magnitudes than those obtained previously for asymmetric and axisymmetric buckling. The three differential equations of the Marguerre type are set up in terms of three displacement quantities as the dependent variable. The equations are formulated so as to allow aribtrary initial imperfections, boundary conditions, and loading to the cap. The computer program set up to solve these equations was checked by successfully solving simpler problems, the solutions of which are in the literature. Although the buckling loads for spherical caps with asymmetric initial imperfections appear reasonable, it is not possible to ascertain at this point whether the cap results are indicative of what the full shell might do. Author

N70-24543 Polytechnical Inst. of Brooklyn, N.Y.
FREE VIBRATIONS OF CIRCULAR CYLINDRICAL WEB-STIFFENED SANDWICH SHELLS
David Ranlet (Ph.D. Thesis) 1969 162 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-20361

An analysis of the free vibrations of simply-supported and clamped web-stiffened, circular, cylindrical sandwich shells is presented. The mathematical model formulated includes the effect of translatory and rotatory inertia in each layer of the sandwich, and assumes that the two face layers may be treated as thin shells in which the classical theory of shells applies, while shear deformation must be taken into account in the core layer. Comprised of annular circumferential web stiffeners only, the structural core is treated as a thick layer of inhomogeneous, orthotropic material. The accuracy of representing the second-order shear modulus by a mean value was verified by means of two, one-dimensional, beam-type problems. Equations are also developed for the free vibrations of the corresponding homogeneously-cored sandwich shells, in order to investigate the effect of smearing-out or averaging a given web-stiffened core.
Dissert. Abstr.

N70-24603 Stanford Univ., Calif.
SOLUTIONS FOR CONCENTRICALLY LOADED ELASTIC RECTANGLES AND RECTANGULAR PARALLELEPIPEDS
Shih-Shang Au (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-13922

The formulation is presented of two exact solutions: one for two-dimensional rectangles; and one for three-dimensional rectangular parallelepipeds, both of these being subjected to a pair of opposing concentrated forces P placed concentrically at the respective surfaces. In solving two-dimensional rectangles of size 2ax2b, two identical Flamant's solutions for semi-infinite plates are first superimposed, which yield besides the concentric forces unwanted shearing and normal tractions along the boundaries. An Airy stress function is then applied repeatedly in such a way that these boundary tractions can be eliminated in successive steps. The solution for the three-dimensional rectangular parallelepiped is formulated in the similar manner. Superposition of Boussinesq's solutions yields concentric forces and unwanted normal traction over the boundaries of the rectangular parallelepiped. Galerkin vectors are then employed to eliminate in successive steps the unwanted normal tractions from the boundaries.
Dissert. Abstr.

N70-24604 Stevens Inst. of Tech., Hoboken, N.J.
NONLINEAR STABILITY OF A BEAM, ON A SPINNING AND PRECESSING ROTOR
Victor David Cohen (Ph.D. Thesis) 1969 150 p

Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-21286

The structural stability of a rotating blade undergoing purely flexural vibrations in the plane of spin is examined. The effects that are shown to exert destabilizing influences are the nonlinear coriolis force, the sinusoidal precession of the spin plane, and acceleration of the rate of spin. Aerodynamic effects are excluded since what is sought is solely the structural behavior of the system subjected to mechanically excited forces and the system's interaction with those forces. The problem is developed stage by stage by examining a rotating beam with tip mass where the kinetic energy of the beam is assumed to be much less than that of the tip mass. The coriolis force causes the describing equation of motion to be nonlinear. Instability is predicted as a function of the initial conditions due to the autonomity of the problem. The sinusoidal precession considered without the coriolis force results in an equation that resembles a Mathieu equation. Dissert. Abstr.

N70-24605 Virginia Polytechnic Inst., Blacksburg.
THE ROLE OF STRESS CONCENTRATIONS IN STRUCTURAL FATIGUE
John Harold Crews, Jr. (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-19970

Fatigue behavior at stress concentration sites under cyclic loading is analyzed. Specifically, the study treats sheet specimens containing a central hole under remote uniaxial cyclic loading. The investigation was conducted in three phases: an analysis of local cyclic stress-strain conditions at the stress concentration site, an investigation of fatigue crack initiation, and a study of the initial stage of crack propagation for cracks growing from the stress concentration site. Because fatigue cracks in structures originate at stress concentrations, rational methods for estimating crack initiation must be based upon cyclic stress-strain conditions at typical stress concentration sites. Cyclic stress and strain were estimated for this point by cycling uniaxial coupons between calculated limits for the local stress and strain. The adequacy of this analytical-control procedure was demonstrated by a comparison of calculated results with experimental results obtained on a companion specimen. Comparisons were made for constant-amplitude, two-level, and random loading. Dissert. Abstr.

N70-24621 Pennsylvania Univ., Philadelphia.
COUPLED THERMOPLASTICITY WITH APPLICATIONS TO THICK-WALLED SPHERES
Herman Arthur Nied (Ph.D. Thesis) 1969 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-21411

Using the fundamental equations of mechanics and the principles of irreversible thermodynamics, the governing equations of coupled thermoplasticity are derived. Based on this theory, a general boundary value problem of coupled thermoplasticity was formulated and specialized for a spherical domain. In order to investigate the temperature-stress coupling effect by analytic methods rather than numerical techniques, several simplifying assumptions are introduced which reduce the general formulation to a quasi-static coupled thermoplasticity theory. An approximate solution to the problem of a quasi-static coupled spherical media subjected to either a prescribed radially symmetric pressure or temperature field was obtained by using a power series in terms of a thermoplasticity coupling parameter suggested from a non-dimensionalization of the governing equations. Dissert. Abstr.

N70-24642 Polytechnic Inst. of Brooklyn, N.Y.
SHELL THEORY FOR THICK CIRCULAR CYLINDERS
Eugene Barry Golub (Ph.D. Thesis) 1969 145 p
Avail: Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-20336

Thick shell equations of circular cylinders under axisymmetric load are developed by assuming a stress and displacement state that is a generalization of the classical thin shell theory, i.e., the in-plane stresses contain, in addition to the classical membrane and bending stress resultants, higher-order self-equilibrating stress resultants. The governing differential equations and the associated boundary conditions are obtained by utilization of Reissner's variational principle in conjunction with the generalized stress and displacement state. Comparison of results obtained from known elasticity solutions shows that the present solution accurately represents the stress and displacement states for shells with mean radius to thickness ratios of the order of 3.0 Dissert. Abstr.

N70-24656# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
FOUNDATIONS AND SUBSURFACE STRUCTURES IN SNOW
Malcolm Mellor Oct. 1969 64 p refs
(AD-699336; CRREL-CRSE-3-A2C) Avail: CFSTI CSCL 13/13

Various types of foundations suitable for use in very deep snow are described, and design principles are given. Dependence of settlement rate on heaving pressure, size and shape of foundation, snow temperature, and snow density is treated analytically, and field data from test procedures for foundation design are outlined. In treating the design of tunnels, shafts and subsurface structures in very deep snow, the distributions of stress, strain and displacement in polar ice sheets are first obtained analytically. Observed patterns of deformation are given for a variety of excavations and deformable structures, and methods of analysis are put forward. The loading of restraining structures is discussed, and finally some notes on the monitoring and maintenance of subsurface structures are given. Author (TAB)

N70-24699# Eidgenossische Technische Hochschule, Zurich (Switzerland).
BONDING AND TORSION OF THIN-WALLED STRAIGHT AND CURVED BEAMS WITH VARIABLE OPEN CROSS-SECTION
Suresh Lonkar (Ph.D. Thesis) 1969 82 p refs /t/ Dissertation No. 4154
Avail: CFSTI

The general case of bending and torsion of thin walled beams of unsymmetrical section is discussed. A system of four fourth order ordinary differential equations is presented. Closed homogeneous solutions are given and the particular integrals are obtained for some cases of loading. The solutions are used to obtain transport matrices for straight and curved beams. The theory is extended to beams of variable cross section using the Finite Elements method. A short description of the computer program prepared for the statistical analysis of thin walled beams of open cross section is given. The problem of skew supports is discussed. Author

N70-24707 Polytechnic Inst. of Brooklyn, N.Y.
POSTBUCKLING OF IMPERFECT CIRCULAR CYLINDRICAL SHELLS UNDER HYDROSTATIC PRESSURE
Harvey H. Liss (Ph.D. Thesis) 1969 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20346

The present work applies a large-deflection energy analysis to an initially deformed, circular cylindrical shell under an external hydrostatic pressure. The general form of the nonlinear algebraic equations which result when a Rayleigh-Ritz procedure is applied to an assumed deflection function consisting of an infinite trigonometric series is presented. Initial imperfections are also represented by a similar infinite series. The equations are solved by use of a digital computer for a deflection function allowing five degrees of freedom. In addition to providing load vs. deflection curves more complete in the postbuckling region than in previous work, one more degree of freedom is permitted in the deflection function. Although the load vs. deflection curves obtained indicate initial imperfections do not significantly affect the minimum postbuckling pressure, there is suggestion that imperfections affect the pressure at which actual snap-through occurs. Dissert. Abstr.

N70-24708 Polytechnic Inst. of Brooklyn, N.Y.
THICKNESS INFLUENCE ON THE STABILITY OF A THICK-WALLED CIRCULAR CYLINDER UNDER THE COMBINED ACTION OF AXIAL COMPRESSION AND LATERAL PRESSURE
Shih-chung Ma (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-20348

The problem of the thickness influence on the stability of a thick-walled circular cylinder of homogeneous and isotropic material under the combined action of axial compression and lateral pressure is formulated by application of the three-dimensional nonlinear theory of elasticity. As compared with most of shell theories, no restrictive assumptions are made concerning the thickness of the wall of the cylinder, and the displacements and strains are not assumed to be small. The most important gain is that its solutions reveal the unrestricted dependency of the prebuckling and most of buckled quantities on the thickness direction of the cylinder. These thickness effects are studied quantitatively and subsequently compared with the solution based on the classical shell theories. The buckling stress based on the present theory is in general lower than the results based on the classical theory. It concludes that thickness deformations have influence of similar degree on the stability of axial compressed cylinder as the influence due to edge constraints in the classical shell theories.
Dissert. Abstr.

N70-24710 Polytechnic Inst. of Brooklyn, N.Y.
CREEP ANALYSIS OF SHELLS BY ENERGY METHODS
Ming Cheng Chen (Ph.D. Thesis) 1969 64 p
Avail:Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-20321

The application of the theorems of minimum total potential and minimum complementary potential to the creep analysis of shells is considered. The energy relations used here have been obtained by direct integration of the stresses and strains over the thickness of the shell. Such an integration gives rise to cross product terms between the curvatures and the extensional strains in the strain energy and also, between the membrane stresses and the bending stresses in the complementary energy. With the use of the derived energy expressions, a long circular cylindrical shell subject to uniformly applied edge moments with and without axial loads has been analyzed. The results so obtained are compared with those computed here on the basis of simplified energy expressions suggested by earlier investigators.
Dissert. Abstr.

N70-24721 Pennsylvania Univ., Philadelphia.
A LARGE DEFLECTION THEORY FOR THIN ELASTIC SHELLS
Robert George Jeffers (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-21374

This dissertation is concerned with the development of a large deflection theory for thin elastic shells. The kirchhoff hypothesis on the vanishing of the transverse shear and normal strains is made. In addition it is assumed that the strains are small compared to the rotations. The rotations are assumed to be such that squares of the rotations can be neglected compared to unity. The shell theory is derived from concepts in three dimensional finite elasticity. Starting with the three dimensional strain energy density function, the constitutive equations for the shell are obtained. These are obtained both for a general strain energy form and also for a linear elastic material. The shell theory thus obtained is applied to some simple illustrative examples. The theory is used to investigate the stability and post-buckling behavior of a circular arch. It is also applied to a circular plate with the results showing when the linear plate theory is applicable.
Dissert. Abstr.

N70-24728 Catholic Univ. of America, Washington, D.C.
INVESTIGATION OF IMPACT OF RIGID AND ELASTIC BODIES WITH WATER
Sheng-Lun Chuang (Ph.D. Thesis) 1969 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-19918

Tests of deformable models verified the fact that the impact pressure generated by the impact of the deformable body is affected by the vibratory movement of the impact surface, and it can be separated into the rigid body impact pressure and the interacting pressure. This dynamic interaction is closely related to the hydrodynamic phenomenon rather than to the acoustic phenomenon. Therefore, the determination of the structural response requires the inclusion of the hydrodynamic added mass and the fluid damping terms in the equation of motion. Results have demonstrated (1) that water can be treated as an incompressible fluid regardless of the size of the deadrise angle, (2) that trapped air must be taken into consideration for small deadrise angles, and (3) that the structural response to an impact load can be treated as the impact of a deformable body on an incompressible fluid, with or without trapped air.
Dissert. Abstr.

N70-24732# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
ACOUSTIC STRENGTH TESTS AS A BASIS FOR ESTABLISHING DESIGN DIAGRAMS [SCHALLFESTIGKEITSVERSUCHE ZUR ERSTELLUNG VON BEMESSUNGSDIAGRAMMEN]
G. Bayerdoerfer and R. Carl 1969 33 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The acoustic stresses encountered by aircraft structural shells were simulated in a sonic test channel and applied to several test structures. The location of stress concentration in the shell skin and the resonant frequencies effects on life estimates were determined. Simple riveted joints were subjected to vibration fatigue tests, and the most important stress parameters were determined.
ESRO

N70-24746# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE EFFECTS OF EXTRANEOUS NOISE ON THE MEASUREMENT OF THE FREQUENCY RESPONSE OF STRUCTURAL UNDER TRANSIENT EXCITATION
F. Kandianis Nov. 1969 95 p refs Sponsored by Min. of Defense
(ISVR-TR-20) Avail: CFSTI

Transient testing techniques were extensively used in determining the behavior of a dynamic system and as a means of obtaining its frequency response. The research work involved the determination of the frequency response of structures by transient testing techniques and was focused on the effects of extraneous noise on the estimate of the frequency response function. The deterministic approach of estimating the frequency response function of a structure by taking the Fourier transform of its transient response is shown to yield very poor results when noise is present either as additional excitation to the structure or at the response. Consequently, probability theory was used in the analysis and it is shown that noise at the response of a system affects the estimates of its frequency response function derived from either the power spectral density function or the autocorrelation function of the response. The theoretical study is completed by development of a novel analysis technique by which accurate estimates of the frequency response function of the structure may be obtained from transient tests carried out under noisy environmental conditions. The final part of the work presents an estimate of the frequency response of a ship structure based on transient tests.
Author (ESRO)

N70-24758# Hamburger Flugzeugbau G.m.b.H. (West Germany).
CONTRIBUTION TOWARDS THE THEORETICAL BASIS FOR CALCULATING SANDWICH STRUCTURES WITH TUBULAR CORES [BEITRAG ZUR THEORETISCHEN

BERECHNUNGSGRUNDLAGE FUER SAMDWICHBAUWEISEN MIT TUBUSKERN]

B. J. Habibie 1969 44 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The shear modulus of the tubular core of a sandwich structure was determined theoretically, and the results were compared to the known moduli of honeycomb cores and of a cellulose acetate tubular core. The buckling values for a tubular plate with equal duraluminum skins and cores made of cellulose acetate or polysulfones were also calculated. ESRO

N70-24786# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE THEORY OF SHELLS OF REVOLUTION OF DIFFERENT MODULI

O. V. Potudin et al [1968] 6 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 6, no. 1, 1970 p 22 - 26
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The edge moments and stress resultants of a shell of revolution loaded by asymetrically distributed forces are considered. The equations for satisfying the stresses, and the relationship of strain components to displacement are given. The stress and strain invariants are evaluated. Using Poisson coefficients for uniaxial tension and compression, and elastic moduli the boundary conditions are derived. It is concluded that the solution of the zero-order system reproduces the results of the classical thin-shell elasticity theory formulated by Love, and the solution of the different modularity problem reduces to solving a modified first boundary value problem. F.O.S.

N70-24774*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASURED VIBRATION RESPONSE CHARACTERISTICS OF FOUR RESIDENTIAL STRUCTURES EXCITED BY MECHANICAL AND ACOUSTICAL LOADINGS

Huey D. Carden and William H. Mayes Washington Apr. 1970 60 p refs
(NASA-TN-D-5776; L-6885) Avail: CFSTI CSCL 20K

Modal patterns, acceleration levels, and spectra resulting from mechanical point load excitation and acoustical excitation of four residential structures are described. Also included are examples of noise-induced rattling of hanging decorative objects. Airplane-noise-induced building responses are compared with responses necessary to induce rattling and with forced sinusoidal responses. Measured indoor and outdoor noise spectra induced by airplanes and noise reduction characteristics of two houses are described for overflights of both propeller-driven and turbofan-powered airplanes. Author

N70-24833# Technisch Physische Dienst TNO-TH, Delft (Netherlands).
MECHANICAL DESIGN OF SPACE EXPERIMENTS: A SHORT REVIEW

A. Hammerschlag *In* Univ. Coll., London Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 55 60 (See N70-24826 11-30)
Avail: CFSTI

The principles of designing spacecraft experiments and structures is discussed, particularly, acceptable vibration levels and cold welding and how the latter difficulty may be avoided by the use of non-welding materials, flexure devices, protective atmospheres or solid lubricants. ESRO

N70-24857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMPLIFICATION OF THE DISPLACEMENT METHOD FOR CALCULATING THE STRENGTH, STABILITY, AND VIBRATIONS OF RIGID TRUSSES

Wang Kuang-Yuan 11 Aug. 1969 19 p refs Transl. into ENGLISH from Tu Mu Kung Cheng Hsueh Pao Mainland (China), v. 7, no. 3, 1960 p 55 - 60
(AD-699236; FTD-HT-23-1478-68) Avail: CFSTI CSCL 13/13

The basic unknowns in displacement methods now used for calculating the strength, vibrations, and stability of rigid trusses are the angles of rotation of rigid joints and the linear displacement of independent joints. In accordance with the method explained in this paper, half or over half of the angles of rotation of joints need not be obtained in order to solve a problem. As a result, the displacement method is simplified. Author (TAB)

N70-24947# United States Steel Corp., Monroeville, Pa. Research Center.
PLANE STRAIN NECKING OF V-NOTCHED AND UNNOTCHED TENSILE BARS

O. Richmond Pittsburgh 1969 15 p refs Submitted for publication *Its* Sci. and Technol. Vol. 16, No. 26
Avail: CFSTI

An analytic, nonsteady solution for plane strain necking of V-notched, rigid/perfectly-plastic tensile bars was obtained. A new analytic solution is given for the problem. The plastic zone does not remain geometrically similar, velocity discontinuities are absent, and plastic flow results in a convex-shaped neck. Comparative measurements of neck profiles obtained under conditions approximating plane strain indicate that the new solution is a good representation of the physical situation in metals. It appears to be useful for estimating basic stress-strain relations from tensile tests after necking, and for estimating the stresses and strains required for fracture from notched bar tests. Author

N70-24974# Australian Aeronautical Research Committee, Melbourne.
SOME PROBLEMS OF FATIGUE LIFE ESTIMATION

F. H. Hooke Oct. 1969 9 p refs
(ARL/SM-344) Avail: CFSTI

The estimation of the fatigue life of aircraft structures is an actuarial problem akin to problems in the life insurance field. In contrast it requires estimation to proceed with minimal structural mortality data, and often with numerous simplifications. The effect of these simplifications is discussed. Author

N70-24982# Royal Aircraft Establishment, Farnborough (England). Ministry of Technology.
THE STUDY OF ELASTO-PLASTIC BEHAVIOUR AT THE ROOT OF A NOTCH AS AN ALTERNATIVE TO PURELY EMPIRICAL METHODS OF FATIGUE RESEARCH [DIE BETRACHTUNG DER ELASTISCH-PLASTISCHEN BEANSPRUCHUNG IM KERBGRUND ALS AUSWEG AUS EINER PHAENOMENOLOGISCH BETRIEBENEN SCHWINGFESTIGKEITSFORSCHUNG]

D. Schutz May 1969 16 p refs Transl. into ENGLISH from the report TB-80, 1968 p 83 - 93
(RAE-LIB-TRANS-1394) Avail: CFSTI

By means of strain gauge measurements, a study has been made of the stress history at the root of a notch in an aluminium alloy specimen subjected to repeated applications of a sequence of representative tensile compressive flight loads. The observed load sequence effects are discussed, and the residual stresses resulting from elastic constraint, subsequent to plastic deformation at the notch root, are shown to appear as changes in mean stress. A stable hysteresis loop was observed to develop after repeated applications of the same load sequence but there was however, some indication of time-dependent stress relaxation. Author

N70-24984# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELASTIC WAVE PROPAGATION IN CYLINDERS WITH LONGITUDINAL CAVITIES

V. T. Golovchan [1968] 3 p refs Transl. into ENGLISH from

Fiz. Tekh. i Matem. Nauk, Dopovidi an UkrSSR, (USSR), ser. A, no. 1, 1970 p 45–47
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A solution of the problem of elastic harmonic wave propagation along a cylinder with a multiconnected cross-section is given herein. The method proposed for the solution of the plane dynamic problem in the case of a multiconnected domain with circular boundaries is utilized. Author

N70-24990 Washington Univ., Seattle.
A STUDY OF THE APPLICABILITY OF THE METHOD OF POTENTIAL TO INCLUSIONS OF VARIOUS SHAPES IN TWO AND THREE-DIMENSIONAL ELASTIC AND THERMOELASTIC STRESS FIELDS
George Edward Walker, Jr. (Ph.D. Thesis) 1969 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-20286

A study of the applicability of the method of potential to the solution of linear elastic three-dimensional problems and in particular to the subset of fracture mechanics problems was conducted. The method requires the solution of a set of singular integral equations which is obtained by using the reciprocal theorem of elasticity and a singular solution to the Navier equations. Through a number of numerical examples the method of potential is shown to be an appropriate technique for the solution of two-dimensional facture mechanics problems, and the development of the three-dimensional formulation for isothermal bodies and the details of the necessary modifications for the consideration of thermal stresses is described. Dissert. Abstr.

N70-24995 Illinois Univ., Urbana.
A METHOD FOR A FORCED VIBRATION ANALYSIS OF A FLAT SKIN-STRINGER-FRAME STRUCTURE
Bruce K. Donaldson (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12107

Method of analysis for the response to forced harmonic vibration of a finite structure composed of a flat plate continuous over, and rigidly attached to, a grid of open section beams is presented. This method of analysis is one in which either the standard beam or thin plate equilibrium equations for small deflections are satisfied everywhere on the structure, yet the beam grid is allowed to have any form, the flat plate to have polygonal cutouts, and the structure as a whole to have any combination of boundary conditions. Finite Fourier series are used to represent the plate edge deflections. Therefore, the equations of continuity and the boundary conditions are only satisfied approximately. An included application of this theory is the solution for the deflection amplitude function of a single polygonal thin plate with any boundary conditions. Dissert. Abstr.

N70-24996 Pennsylvania Univ., Philadelphia.
FREE VIBRATIONS OF CABLE AND MEMBRANE SYSTEMS
Bhaskar S. Chaudhari (Ph.D. Thesis) 1969 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-21332

This dissertation furnishes a comparison between the two basic approaches for the study of the dynamic behavior of cable networks (1) a continuum, in which the cable network is replaced by analogous thin elastic membrane without shear rigidity in the two orthogonal directions, that are parallel to the cables in the network (2) a discrete system, in which mass of the cables is assumed to be concentrated at the node points. From these studies, the continuum approach for the study of the dynamic behavior of cable network is found to be satisfactory. It is shown that the differences in the two approaches is small for large values of span to spacing ratios of the cable networks. Also by adjusting the equivalent mass of the membrane, it is possible to eliminate the difference. Dissert. Abstr.

N70-25010 Arizona State Univ., Temple.
SIMULTANEOUS INTEGRAL EQUATIONS IN VIBRATION ANALYSIS
Michael Thomas Wilkinson (Ph.D. Thesis) 1969 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-20809

A technique which removes some of the difficulties inherent in the integral equation approach to linear, free vibration problems is presented. One essential feature of this simplifying technique is that in lieu of explicitly forming the influence function, the free vibration problem is expressed in the form of a set of simultaneous integral equations. A second convenient feature is the use of an elastic foundation to aid in the formulation of the simultaneous equations. It is shown that the natural frequencies of a solid can be obtained from the natural frequencies of a related problem where the solid rests on an elastic foundation. Finally a numerical procedure is presented for extracting the eigenvalues from the set of simultaneous integral equations. The principal attractive feature of this numerical method is that it is successful in treating a broad class of singular as well as nonsingular integral equations. A proof of convergence of the method is also developed. Dissert. Abstr.

N70-25021 Virginia Polytechnic Inst., Blacksburg.
A PHOTOELASTIC DETERMINATION OF THE EFFECT OF CRACK CLOSURE ON BENDING STRESS INTENSITY
Dallas Glen Smith, Jr. (Ph.D. Thesis) 1969 72 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-19985

Experimental values of the stress intensity were determined by means of the three-dimensional photoelasticity technique of stress freezing and slicing. Plates of epoxy resin were constructed, each containing a central through crack, by joining two plates which contained edge cracks. The plate was loaded in cylindrical bending and subjected to a stress freezing cycle in an oven. The maximum shear stress around the crack tip was studied by separately analyzing thin slices taken from the plate parallel to the middle surface of the plate. For the range of crack length to plate thickness ratios used the results show that due to closure the experimental stress intensity on the tensile surface of the plate is on the order of 9 to 30 per cent higher than the stress intensity predicted by the Hartranft–Sih solution. The results also indicate that for constant plate thickness this difference is larger for long cracks than for short cracks. Dissert. Abstr.

N70-25029 Oklahoma Univ., Oklahoma City.
AN ANALYSIS OF FREE VIBRATION OF THIN CYLINDRICAL SHELLS WITH RINGS AND STRINGERS TREATED AS DISCRETE ELEMENTS WHICH MAY BE NONSYMMETRIC, ECCENTRIC, AND ARBITRARILY SPACED
Keats Endymion Soder (Ph.D. Thesis) 1968 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-12332

The Rayleigh–Ritz technique is utilized with general type displacement modes, which allows different types of end supports to be considered. The effect of stiffener eccentricity, which is the term used when the stiffener's centroid does not coincide with the middle surface of the shell, is included. Also, the effect of a nonsymmetric stiffener, like an angle or z section, is considered. Since the stiffeners are treated as discrete elements, they may be nonuniformly spaced, consist of different materials, and differ in geometry and size. Strain energy due to the normal strain in the direction of the stiffener axis and shear strain due to twisting about the stiffener axis are considered for the stiffeners. The normal strain includes the extension caused by the bending of the stiffener about both cross sectional axes, and the effect of warping of the stiffener cross section due to twisting. Dissert. Abstr.

N70-25043 California Univ., Berkeley.
THE ANALYSIS OF THIN SHELLS BY A FINITE ELEMENT PROCEDURE

C. Philip Johnson (Ph.D. Thesis) 1968 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-13917

A finite element procedure is presented for the analysis of thin shells of arbitrary geometry. The smoothly curved shell surface is discretized by an assemblage of flat triangular elements. The element stiffness properties are derived from assumed displacement functions in the form of truncated polynomials, and triangular coordinates are used for the derivation. Both triangular and non-planar quadrilaterals are utilized, and their stiffness properties are compared. The stiffness properties of the complete assemblage are obtained by the direct stiffness procedure. The treatment of force and displacement boundary conditions is discussed and a direct procedure is used to solve the nodal point equilibrium equations of the assemblage. Practical aspects of a computer algorithm for the solution of large systems of equations which are banded, symmetric, positive definite and sparse is discussed; and typical solution times are recorded. A five degree of freedom nodal point displacement system is used which permits substantial mesh refinement in treating shells with intricacies of geometric detail. The convergence properties with decreasing mesh size for both element types are studied, and the results of several analyses are compared with existing solutions. Dissert. Abstr.

N70-25055 Washington Univ., Seattle.
FINITE ELEMENT FORMULATION OF GEOMETRICALLY NON-LINEAR PROBLEMS OF ELASTICITY
Noel Donald Nathan (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-20255

Nonlinearities of geometrical origin arising either from the strain-displacement relations or from the equilibrium equations are considered. With the intention of providing a perspective for previously reported solutions, a general formulation of the finite element problem is offered. It is then simplified for the special cases of small elongations and shears, small strains and rotations, and, finally, to the classical case in which rotations are neglected. The unrestricted equations are illustrated by application to a plane strain triangle. Evidence of the correctness of the equations is adduced from satisfaction of the required invariance of the stiffness matrices, and from an exact solution to a particular case. The simplified equations are illustrated by application to a one-dimensional element, and are tested by determination of some known stability conditions. Dissert. Abstr.

N70-25056 Pennsylvania Univ., Philadelphia.
LIMIT BEHAVIOR AND STRENGTH OF FIBROUS MATERIALS AND STRUCTURES
Philip Van Doren McLaughlin, Jr. (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-21399

The generalized limit theorems are used to obtain equations for the limit surface of a representative structural element of fibrous membrane in terms of the number, orientation, and limit load of the constituent fibers. The effects of fiber orientation geometry, fiber yielding, fiber buckling, and pullout of fibers from the remaining structure are included in the theory and illustrated with numerical examples. The method and results for membranes are extended to derive limit surfaces for fibrous plate elements having arbitrary in-plane fiber orientation and depth positioning, and which can resist membrane forces, bending moments, and twisting moments. A separate derivation is given for limit surfaces of two layer sandwich plate elements which is valid for sandwich layers having arbitrary limit conditions and not restricted to fibrous materials. Examples illustrating computational procedures are given and include computation of the limit surface of a plate composed of fibers uniformly oriented in the plane and throughout its depth. Dissert. Abstr.

N70-25070# Lockheed Missiles and Space Co., Huntsville, Ala.
VIBRATIONS OF A HALF-PLANE WITH CIRCULAR HOLES
V. T. Golovchan [1969] 3 p refs Transl. into ENGLISH from Prikl. Mekh. (Moscow), v. 6, no. 1, 1970 p 113–116
Avail: CFSTI

The equation of steady harmonic oscillations in a half plane with circular holes is presented as a boundary value problem which describes wave propagation in a compressible fluid. Using polar coordinates, and selecting constants that satisfy the conditions of the rectilinear boundary of the domain, the Fourier coefficients of the relationship of unknowns in a closed infinite system of algebraic equations are derived. F.O.S.

N70-25079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLEXURE, TORSION, AND STABILITY OF THIN-WALLED BARS OF OPEN CROSS SECTION
Chen Tieh-Yun et al 18 Aug. 1969 227 p refs Transl. into ENGLISH of the book "Kuo Fang Yeh Ch'u Pan She" Peking, 1965 p 1–204
(AD-698997; FTD-HT-23-512-68) Avail: CFSTI CSCL 13/13

The book deals principally with the fundamental theories of bending, twisting, and the stability of open thin-walled rods, and the theory of twisting in open thin-walled rod system. TAB

N70-25080# Royal Aircraft Establishment, Farnborough (England).
EXPERIMENTAL DETERMINATION OF THE INERTIA CONSTANTS OF AN AIRCRAFT OR OF A MISSILE [DETERMINATION EXPERIMENTALE DES CONSTANTES D'INERTIE D'UN AVION OU D'UN MISSILE]
H. Loiseau Nov. 1969 26 p refs Transl. into ENGLISH from La Recherche Aerospatiale, no. 120, Sep.–Oct. 1967
(RAE-LIB-Trans-1412) Avail: CFSTI

It is possible to measure all the inertia constants of an aircraft or of a missile by means of a single experimental set up without having to fix separate axes of rotation. For this, it is sufficient to suspend the structure appropriately to obtain the six natural modes determined by the suspension and to introduce these results as data into a computer. If the structure is very flexible and, therefore, if it is not possible to make it oscillate without deformations, it is then necessary to take into account the first natural modes of deformation. Experiments on rigid and flexible models recently carried out have led to accurate results and allow the consideration of full-scale measurements. Our final aim is to provide, by means of a standard ground vibration test plus measurements of the characteristics of the suspension modes, the set of data necessary for flutter calculations and for the determination of all the inertia constants. Author

N70-25089# Royal Aircraft Establishment, Farnborough (England).
SUITABLE CONCEPTS FOR APPLIED FATIGUE RESEARCH [ZIELE EINER PRAXISORIENTIERTEN SCHWINGFESTTIGKEITSFORSCHUNG]
E. Gassner Sep. 1969 26 p refs Transl. into ENGLISH from Shriftenreihe der Fraunhofer-Ges. zur Forder. der Angew Forsch. (German), no. 5, 1968
(RAE-LIB-Trans-1381) Avail: CFSTI

In the estimation and prediction of the fatigue strength behavior of materials and structural components subjected to constant or random elasto-plastic strain amplitudes it is no longer justifiable to consider only elastic nominal stresses. An example is given of a complex load-time history indicating improvements in the accuracy of life prediction to be obtained by using a cyclic stress-strain diagram. The knowledge so accumulated on the close relationship between stress-time history and material behavior leads to a new concept for fatigue strength research and thus to the recognition of a number of urgent problems relating to practical requirements. Author

N70-25113# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
PERTURBATION SOLUTION OF THE ALGEBRAIC EIGENVALUE PROBLEM OF BUCKLING OF SIMPLY SUPPORTED SKEW PLATES
E. S. Nair and S. Durvasula Aug. 1969 25 p refs Supported in part by the Natl. Aeronaut. Lab.
(AE-253-S) Avail: CFSTI

The algebraic eigenvalue problem pertaining to buckling of simply supported skew plates obtained by the use of Rayleigh - Ritz method, was solved approximately using the perturbation method. Numerical results obtained in a few representative cases are presented. The accuracy of the perturbation calculation is assessed in comparison with the available values obtained by the formal calculation and is found to be satisfactory. Author

N70-25115 Polytechnic Inst. of Brooklyn, N.Y.
VOLUME MINIMIZATION OF AXISYMMETRIC THIN PLATES WITH EXPONENTIALLY VARYING THICKNESS SUBJECT TO CONSTRAINTS
Zachary Sherman (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-20366

The material is homogeneous and isotropic, thus minimum volume yields minimum weight. Only uniform load is considered. Such a combination of constraints may be required for pressure-sensitive devices, and where clearances are tight. The state of stress in the plate remains everywhere elastic. Starting with the differential equation of equilibrium and von Mises' yield equation, the necessary mathematics is developed to effect the minimization process, and the resulting equations, containing infinite power series, are solved on the digital computer. Precision is better than 1% throughout. Designs in terms of beta and h sub o are quickly obtained from sets of plotted curves. These curves were plotted for wide ranges of values of the variables, for the plate both simply supported and clamped at the boundary. Example problems are solved with the use of the plotted curves. Dissert. Abstr.

N70-25124# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 1, NO. 6
1969 22 p refs
(AD-698505) Avail: CFSTI CSCL 20/11

Book reviews are given on: 'The Physics of Vibration and Waves,' 'The Acoustical Foundations of Music,' and 'Theory and Practice of Cushion Design.' A preview of an applied mechanics conference lists report titles on: dynamics, shell dynamics, waves and vibrations in shells, waves in bounded solids, characterization of the dynamic behavior of materials, and waves in composites. Also included is a review of a symposium on industrial noise. Abstracts from current literature are listed under the following headings: analysis and design methods, excitation, phenomenology, experimentation, components, and systems. E.M.C.

N70-25135 Polytechnic Inst. of Brooklyn, N.Y.
A UNIFIED ACCOUNT OF ANALYTICAL METHODS FOR UPPER AND LOWER BOUNDS TO EIGENVALUES OF BEAM AND COLUMN PROBLEMS
John G. Pulos (Ph.D. Thesis) 1969 316 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.05 Order No. 69-20360

Several analytical methods are discussed for finding upper and lower bounds to the eigenvalues of one-dimensional elastic systems. Notable among these is the class of variational methods which include: the well-known Rayleigh Principle (minimum potential energy) and the Ritz extension thereof to the higher eigenvalues, and the methods of Grammel and of Timoshenko (minimum complementary energy). Also included are: the Bubnov - Galerkin method; the Stodola - Vianello method of successive approximations; the concept of Schwarz quotients; the enclosure theorem and Collatz bounds; the bracketing theorems of Temple and Kato; and Temple - Kato - Kohn bounds. Dissert. Abstr.

N70-25146 Colorado Univ., Boulder.
THE FREE VIBRATION ANALYSIS OF DISCRETE SYSTEMS BY MODAL SUBSTITUTION
Robert Laszlo Bajan, Jr. (Ph.D. Thesis) 1969 205 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-19520

A method of analysis is presented for determining accurate natural modes and frequencies of large discrete undamped structural systems. The method utilizes the lumped parameter and modal methods, and iteratively incorporates incomplete modal coupling. Incomplete modal coupling reduces the order of the system eigenvalue problem. The analysis is limited to linear conservative holonomic systems whose motion can be described by small displacement theory. The system matrix equation for free vibration is formulated by incomplete modal coupling, employing the connection matrix to ensure compatibility at connections between adjacent subsystems. Improvement of the approximate system modes calculated by incomplete modal coupling, without increasing the size of the resultant eigenvalue problem, is obtained by application of the modal substitution method, a variation of the Rayleigh - Ritz method. Dissert. Abstr.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-23920# North Carolina State Univ., Raleigh. School of Engineering.
A STUDY OF THE OPERATING CHARACTERISTICS OF THE HEAT PIPE. PART 4: HEAT TRANSFER IN THE EVAPORATOR ZONE OF A HEAT PIPE Final Report
J. K. Ferrell and H. R. Johnson Apr. 1969 150 p refs
(Contract AT(40-1)-3411)
(ORO-3411-12-Pt-4) Avail: CFSTI

The heat transfer mechanism in the evaporator section of a heat pipe was studied. Since several operating features of a typical heat pipe tend to complicate an experimental investigation of the heat transfer phenomena in the evaporator section, a controlled environment heat pipe was designed and operated. The controlled environment heat pipe was divided into an adiabatic section and an evaporator section. Both sections consisted of a rectangular duct which was completely filled with small particles to form a porous wick. One end of the adiabatic section was immersed in a pool of the working fluid which flowed by capillary action to the evaporator section where it was vaporized. The upper surface of the wick in this section was uncovered to permit disengagement of the vapor. Experimental data were obtained to determine the relationship between heat flux and temperature difference between the heated surface and the wick and to determine the limiting operation conditions. Author (NSA)

N70-23933*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.
PRELIMINARY DESIGN OF A HIGH TEMPERATURE SPACE MANUFACTURING FURNACE
V. Wayne Sparks Jan. 1970 60 p refs
(Contract NAS8-21347)
(NASA-CR-102604; HREC-1347-4; LMSC/HREC-D162015) Avail

CFSTI CSCL 20M

A preliminary thermal design analysis has been performed for developing a high-temperature space manufacturing furnace that will be used for melting a glass specimen in the orbital workshop. A nominal furnace with a 150-watt heat input was selected as a basic design about which parametric investigations were conducted. Parameters considered were insulation material, insulation material thickness, and spacing between components of the furnace. A thorough investigation was made to determine the best insulation material which would be applicable to the 2600 F 0.0001 torr environment. Types of insulations considered were foams, powders, fibers, and systems composed of an insulation material with refractory radiation shields. A discussion is presented of the properties and limitations of these materials along with recommendations for their use on the high-temperature furnace. Transient thermal analyses were performed on the nominal furnace design considering each recommended insulation material, insulation material thickness and spacing between components of the furnace for evaluating heat-up and cool-down rates of the glass specimen. Author

N70-23941# Oak Ridge National Lab., Tenn.

NUMERICAL EVALUATION OF THE VELOCITY AND TEMPERATURE STRUCTURE IN LAMINAR CELLULAR CONVECTION BETWEEN PARALLEL RIGID SURFACES

J. L. Wantland Dec. 1969 204 p refs

(Contract W-7405-eng-26)

(ORNL-4458) Avail: CFSTI

A single hexagonal Benard cell is idealized as consisting of a vertically oriented right circular with two dimensional axisymmetric flow. The fluid is assumed to be Newtonian and the Boussinesq approximation is used in the full Navier – Stokes equations. The numerical technique is based on the MAC method. For prescribed values of the Rayleigh number and the cylinder diameter-to-height ratio, the program provides tables of the horizontal and vertical velocity components and the temperature field (in dimensionless forms). The horizontally averaged vertical temperature profile and the Nusselt number are also computed. Although transient results can be obtained, only steady state values are reported. The maximum velocity was found to be the vertical velocity on the centerline and slightly above mid-height. Author (NSA)

N70-24061*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A NUMERICAL STUDY OF CAVITY RADIOMETER EMISSIVITIES

C. L. Sydnor 15 Feb. 1970 29 p refs

(Contract NAS7-100)

(NASA-CR-109448; JPL-TR-32-1463) Avail: CFSTI CSCL 20M

Approximate and exact calculations of apparent emissivities were made for a varity of gray, uniform, isothermal, and Lambertian cavities. Some of these cavities are used in radiometers at the Jet Propulsion Laboratory. For a surface emissivity of 0.95, the cavity emissivity varied from 0.9820 for a simple cone of apex half-angle equal to 11.75 deg, to 0.9963 for a three-section cavity that was roughly semispherical in shape. An error analysis showed that the estimated error in the calculations was four parts in 100,000. A perturbation method showed that in the cone cavity the surface was not actually isothermal but had a temperature variation of 0.5 C. The effect of this non-isothermality on the apparent cavity emissivity was to change it from 0.9820 to 0.9809, for a surface emissivity of 0.95. Corresponding figures for one of the three-section cavities studied were 0.13 C for the temperature variation and a change from 0.9909 to 0.9923 for the cavity emissivity. When the surface emissivity was assumed to have a particular dependence on wavelength, the cavity emissivity was shown to vary from 0.9676 at 250 K to 0.9698 at 500 K as a result of the shift in the peak of the blackbody function. Corresponding figures for a three-section cavity were from 0.9848 at 250 K to 0.9858 at 500 K. For comparison, a flat plate with the same assumed wavelength dependence of emissivity was shown to vary from an effective emissivity of 0.9127 at 250 K to 0.9183 at 500 K. Author

N70-24094# California Univ., Los Angeles. Dept. of Physics.

A SPECIFIC HEAT AND FOURTH SOUND MEASUREMENT OF SIZE EFFECTS IN LIQUID HELIUM

Stephen Allan Scott Dec. 1969 84 p refs

(Contract N00014-67-A-0111-0019)

(AD-699162; TR-31) Avail: CFSTI CSCL 20/13

An experimental and theoretical investigation of liquid helium confined to the small pores of highly compressed powders was made in order to investigate size effects in liquid helium. The specific heat measurements show that the bulk specific heat singularity is replaced by a flattened peak that is shifted towards lower temperatures with decreasing pore size. The theory of second order phase transitions was used to calculate the specific heat of liquid helium in finite systems. The superflow onset temperature and the super fluid fraction were determined from fourth sound (hydrodynamic pressure waves) measurements in the same powders in which specific heat measurements were made. The onset temperature and the temperature of the specific heat peak are equal within experimental error. Author (TAB)

N70-24142# Naval Ordnance Lab., White Oak, Md.

A NEW TECHNIQUE FOR DETECTING THE INITIAL REACTION OF PRIMARY EXPLOSIVES INITIATED BY HOT WIRE

Howard S. Leopold 7 Nov. 1969 28 p refs

(AD-699034; NOLTR-69-148) Avail: CFSTI CSCL 19/1

A technique for sensing the initial reaction of primary explosives initiated by a hot wire has been developed. Exploratory shots were made with lead azide, silver azide, basic lead styphnate, and normal lead styphnate using a capacitor discharge to heat the bridgewire. Results with the technique show that initiation can occur not only during the bridgewire temperature rise but can also occur on the cooling curve of the wire well after cessation of the capacitor discharge. Author (TAB)

N70-24174# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER AND RESISTANCE IN THE LAMINAR FLOW OF LIQUIDS IN TUBES, VOLUME 1

B. S. Petukhov 15 Aug. 1969 254 p refs Transl. into ENGLISH from the Russian

(AD-699255; FTD-HT-23-757-68-Vol-1) Avail: CFSTI CSCL 20/13

Contents: Basic equations; Determining the heat flow, heat-transfer coefficient, and hydraulic resistance; Properties of liquids and gases essential to heat-exchange calculations; Analysis of flow and heat exchange in tubes by the similarity method; Isothermal flow; Heat exchange in round and flat tubes with constant physical properties of the fluid and boundary contitions of the first kind; Heat exchange and resistance in flat and round tubes with variable physical properties of the fluid and boundary conditions of the first kind; Heat exchange in flat and round tubes with constant physical properties of the fluid and boundary conditions of the second kind; Heat exchange and resistence in round tubes with variable physical properties of the fluid and boundary conditions of the second kind. TAB

N70-24178*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

STUDY OF THERMAL CONDUCTIVITY REQUIREMENTS. VOLUME 1: HIGH PERFORMANCE INSULATION THERMAL CONDUCTIVITY TEST PROGRAM Interim Report

D. V. Hale Jan. 1969 108 p refs

(Contract NAS8-21347)

(NASA-CR-102602; HREC-1347-1; LMSC/HREC-D148611-1) Avail: CFSTI CSCL 20M

A glass fiber cylindrical calorimeter was developed to measure temperature-dependent thermal conductivity for high performance insulation over a mean insulation temperature range from cryogenic temperatures to the upper temperature limit of the insulation. The

ability of the device to operate accurately with a small temperature drop through the insulation (as small as 10 F) is due to its design. By eliminating insulation edges with the end caps and by the electronic automation of the four guard heaters, a thermal system results which closely approximates an infinite cylinder. The insulation backside pressure is recorded for each specimen with an ion gage installed in the calorimeter tube. The new device was used to test the thermal conductivity of five high performance insulation materials over a temperature range of −100 to 200 F and a pressure range of 0.000008 torr to one atmosphere. Samples tested were: (1) Unperforated double-aluminized Mylar (1/4-mil) and 0.028-inch red polyurethane foam. (2) Perforated double-aluminized Mylar (1/4-mil) and 0.028-inch red polyurethane foam. (3) Embossed aluminized Mylar (1/4-mil). (4) Embossed aluminized Mylar (1/4-mil)and Dimplar. (5) Embossed aluminized Mylar (1/4-mil)and nylon net. Author

N70-24179*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

STUDY OF THERMAL CONDUCTIVITY REQUIREMENTS. VOLUME 2: MULTIPLE DOCKING ADAPTER (MDA) THERMAL MODEL Interim Report

R. O. Hadden Dec. 1968 80 p refs

(Contract NAS8-21347)

(NASA-CR-102603; LMSC/HREC-D148611-2; HREC-1347-2) Avail: CFSTI CSCL 22B

Two mathematical models, for use in detailed thermal analyses of the multiple docking adapter, were developed and checked out. These were: the multiple docking adapter thermal model and the Apollo Applications Program cluster thermal model which determine the steady-state and/or the transient temperature distribution throughout the multiple docking adapter for a completely realistic set of boundary conditions. These models were written for use with two existing computer programs: The heat rate computer program, and the Mark 5C thermal analyzer. These two programs provide the capability for complete thermal analyses of the multiple docking adapter in any of its many planned orbital configurations. The effect of module rearrangements, surface finish changes, solar panel and module configuration changes can be evaluated. Also, internal heat load changes, experiment surface finish changes, structural changes, as well as most of the other changes which affect the multiple docking adapter temperature distributions can be evaluated using these computer models. Author

N70-24180*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

STUDY OF THERMAL CONDUCTIVITY REQUIREMENTS: MSFC 20-INCH AND 105-INCH CRYOGENIC TANK ANALYSES Interim Report

D. V. Hale Jun. 1969 30 p refs

(Contract NAS8-21347)

(NASA-CR-102601; HREC-1347-3; LMSC/HREC-D148760) Avail: CFSTI CSCL 20M

The storage tanks were analyzed using a computer program incorporating the natural convection along the walls of the tanks and the thermal effects of transfer of the venting gas. Three methods were used, assuming the venting gas to be stationary, and its temperature constrained only at the liquid surface and at the top of the vent line; the gas to be stationary and its temperature fixed at the evaporation temperature at all points; and the gas to be flowing out the vent line at the rate dictated by boiloff and its temperature constrained only at the liquid surface and the top of the vent line. For the 20-inch tank the heat leak to the liquid for the three methods were 7.58, 4.15, and 5.79 Btu/hr, respectively. Test data revealed a mass boiloff rate of 0.0508 lbm/hr which corresponds to a heat leak to the liquid of 4.38 Btu/hr. For the 105-inch tank, the heat leak to the liquid were 133.37, 79.52, and 85.99 But/hr, respectively. These results indicate that the approximations made in the analysis concerning the venting gas have a significant effect on the predicted heat rate. Author

N70-24181*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

STUDY OF THERMAL CONDUCTIVITY REQUIREMENTS: HIGH PERFORMANCE INSULATION Final Report

D. V. Hale and M. J. O'Neill Feb. 1970 79 p refs

(Contract NAS8-21347)

(NASA-CR-102600; LMSC/HREC-D162128; HREC-1347-5) Avail: CFSTI CSCL 20M

An experimental study was performed to determine if high temperature baking of Mylar/polyurethane foam insulation composite could lower thermal conductivity of this high performance insulation specimen by expelling unwanted gases which had been absorbed, adsorbed, or chemisorbed within the composite. After being totally outgassed, the specimen was exposed to the atmosphere, and after exposure for more than three weeks, no degradation was found. An experimental study was also conducted for three insulation systems which had as a spacer material polyurethane foam with slot cutouts. The best of these had a conductivity as low as conventional Mylar/foam composite and a density of about one-half the density of the conventional composite. Standard thermal conductivity testing was conducted for four other high performance insulation composites, yielding conductivity as a function of temperature, and room-temperature conductivity as a function of pressure. An insulation system was designed and fabricated for a 20-inch diameter subscale cryogen storage tank. A comparison was made between thermal conductivity data obtained with the cylindrical calorimeter, and thermal conductivity predictions based on semi-empirical correlations. Author

N70-24257*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A STUDY OF RADIATION HEAT TRANSFER FROM A CYLINDRICAL FIN WITH BASE SURFACE INTERACTION

Charles A. Cothran Washington Apr. 1970 93 p refs

(NASA-TN-D-5722; M362) Avail: CFSTI CSCL 20M

This paper presents a study of the temperature distribution of a cylindrical fin transferring heat simultaneously by internal conduction and by surface radiation. The temperature distribution was studied considering the fin only and the more complex case of surface interactions with a circular base. Equations are derived for the temperature distribution of the fin only, the fin with base surface interactions when both surfaces are black, and also the case of gray diffuse surfaces. Solutions to the equations are obtained by numerical techniques, the analysis is verified experimentally, and the results are given. Author

N70-24293*# Bureau of Mines, Pittsburgh, Pa. Safety Research Center.

PHYSICAL AND EXPLOSION CHARACTERISTICS OF HYDRAZINE NITRATE

Harry K. James, Yael Miron, and Henry E. Perlee Mar. 1970 26 p refs

(NASA Order T-39882-G)

(NASA-CR-109491; BM-IC-8452) Avail: Issuing Activity

Experimental studies of the physical and explosion characteristics of pure hydrazine nitrate and multicomponent systems containing hydrazine nitrate, supplemeted with an extensive literature survey, are presented. Such properties as melting point, heat of fusion, density, viscosity, surface tension, thermal stability, decomposition process, detonation velocity, impact sensitivity, and TNT equivalence are included. Author

N70-24312*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

TWO PHASE DETONATION STUDIES RELATED TO ROCKET INSTABILITY, 1969 Annual Report, 1 Feb. 1969 1 Feb. 1970

J. A. Nicholls 11 Mar. 1970 41 p refs

(Grant NGL-23-005-336)

(NASA-CR-72668; UM-02603-1-P) Avail: CFSTI CSCL 21B

Results of the study are reported and include: (1) The details of the ignition of single fuel drops by a shock wave. (2) The development of a system for producing a controlled distribution of fuel drop sizes in an oxidizing atmosphere for two phase detonation studies. (3) The attenuation of shock and detonation waves passing over an acoustic liner. (4) A simplified theory for the propagation of film detonations. (5) A simplified analytical model of a rotating two phase detonation wave in a rocket motor. Author

N70-24428 Advisory Group for Aerospace Research and Development, Paris (France).

NOZZLE FLOW AND CHARACTERISTIC PARAMETERS

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 37–105 refs (See N70-24426 11-27)

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Theoretical considerations for solid propellant rocket nozzle design are presented. Formulas are derived for the characteristic parameters of the quasi-one-dimensional theory, an idealization of the equations of aerothermochemistry. Ways in which real rocket systems deviate from the ideal behavior are discussed, and the effects of multicomponent, reacting gas flow and two-phase flow are described. Heat transfer from the gasses to the nozzle walls and methods of thrust vector control are considered. The advanced expansion-deflection nozzle design is mentioned. N.E.N.

N70-24435 Advisory Group for Aerospace Research and Development, Paris (France).

EXPERIMENTAL ASPECTS OF COMBUSTION INSTABILITY

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 555–603 refs (See N70-24426 11-27)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Experimental methods employed in the analysis of combustion instabilities are discussed. Fundamental, experimental results obtained for linear, acoustic instability are reviewed. Experiments on acoustic instabilities in rocket engines are considered. The relatively small amount of experimental information available on nonacoustic and nonlinear instabilities is described. Author

N70-24436 Advisory Group for Aerospace Research and Development, Paris (France).

THEORETICAL ANALYSES OF COMBUSTION INSTABILITY

In its Fundamental Aspects of Solid Propellant Rockets Oct. 1969 p 605–673 refs (See N70-24426 11-27)

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A rather well-defined theoretical framework exists for linear acoustic instabilities. But for nonlinear instabilities and for nonacoustic instabilities, there are only isolated theoretical analyses of a few specific mechanisms. Therefore, emphasis is on linear acoustic combustion instability. Acoustic vibrational modes are discussed, the basis for describing acoustic amplification is presented, and the available analyses of acoustic damping mechanisms are reviewed. Theoretical studies of the heart of the problem of linear acoustic instability, analyses of the acoustic amplification mechanism, are considered. Existing theories of nonlinear and nonacoustic instabilities are discussed, and a few remarks concerning comparison of theory with experiment are made. Author

N70-24476# Cincinnati Univ., Ohio.

EQUILIBRIUM MEASUREMENTS IN HIGH MELTING MATERIALS, 1 APR. 1968–30 JUN. 1969

M. Hoch Oct. 1969 31 p refs

(Contract F33615-67-C-1445)

(AD-698358; AFML-TR-69-278) Avail: CFSTI CSCL 20/13

The methods available to determine the specific heat of metals at elevated temperature are reviewed. All methods used give data which agree with each other. The high temperature specific heat for metals can be represented by an equation of the type C sub p = 3RF (theta sub D/T) + cT + dT to the 3rd power between theta sub D, the Debye temperature and the melting point. The rapid rise in specific heat at high temperatures is due to the contribution of anharmonic vibrations to the specific heat and not to the formation of vacancies. The accuracy of 1% in the specific heat data available presently is not sufficient to determine the energy and entropy of formations of vacancies, and their concentration. Author (TAB)

N70-24480# Oak Ridge National Lab., Tenn.

CONDENSATION ON FLUTED SURFACES

L. A. Kurtz (Ph.D. Thesis—Tennessee Univ.) Dec. 1969 87 p refs

(Contract W-7405-eng-26)

(ORNL-4479) Avail: CFSTI

The condensation of vapor on a fluted surface is studied. Due to the large surface tension on the liquid film, the condensate is drained away and thus the efficiency of the condensation process is increased. The motion of the liquid film can be described—after some simplifications—by a fourth-order nonlinear parabolic partial differential equation. A difference scheme is developed to approximate this differential equation and the questions of stability and convergence are investigated. Due to the nonlinearity of the problem the stability of this numerical procedure depends on several parameters. Artificial constant initial values must be given. Within the limits of stability these artificialities are rapidly smoothed out, and in fact the effect of a change in the initial conditions dies out with an increasing number of iterations. Some numerical experiments are carried out with this scheme and the results are discussed. Author (NSA)

N70-24491# Rutgers Univ., New Brunswick, N.J. Dept. of Mechanical and Aerospace Engineering.

EXPERIMENTAL INVESTIGATION OF BLUNT BASE HEAT TRANSFER IN AN AXISYMMETRIC TURBULENT SUPERSONIC SEPARATED FLOW

U. S. Fletcher Jul. 1969 54 p refs

(Contract F44620-68-C-0018)

(AD-698783; RU-TR-128-MAE-F; AFOSR-69-2149TR) Avail: CFSTI CSCL 20/13

The heat transfer from a blunt base immersed in an axisymmetric turbulent supersonic separated flow was experimentally measured. The investigation was conducted at a Mach number and Reynolds number per foot of 3.88 and 16,700,000, respectively. Experimental heat transfer data, determined by a transient heat transfer technique, were obtained for both heated and cooled base conditions. A series of three models were used, permitting the measurement of an average value of base heat transfer, as well as the angular and radial variations. The experimental data obtained in the investigation were compared with published experimental data and with recently published correlating parameters for both base heating and base cooling. Author (TAB)

N70-24516# Sandia Corp., Albuquerque, N.Mex.

A PROCEDURE FOR COMPUTING AERODYNAMIC HEATING ON SPHERE CONES, PROGRAM BLUNTLY. VOLUME 2: EQUATIONS, OPERATING PROCEDURE, AND PROGRAM DETAILS

G. J. Hochrein Nov. 1969 97 p refs Sponsored by AEC

(SC-DR-69-449) Avail: CFSTI

A procedure for computing aerodynamic heat transfer rates to sphere cones at zero angle of attack is presented. This procedure employs curve fits of the shock shape and static pressure distributions together with a streamtube mass balancing technique to compute the necessary flow-field properties. Computations can

be performed for an ideal gas or for air in thermodynamic equilibrium. A computer program, BLUNTY, is based on this procedure. This program serves as a useful tool for quickly computing accurate heat transfer distributions on sphere-cone reentry vehicles. Volume I presents a general description of the procedure used in program and a comparison of program results with actual flight data. This volume presents the equations, operating procedure, and details of the program. Author (NSA)

N70-24526 Arizona State Univ., Tempe.
A GENERALIZED QUANTITATIVE CRITERION TO PREDICT THE RATE CONTROLLING MECHANISM FOR GROWTH OF VAPOR BUBBLES IN UNIFORMLY SUPERHEATED LIQUIDS
Ali Salman Al-Jubouri (Ph.D. Thesis) 1969 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-20749

Vapor bubble growth rates were investigated theoretically with a view to obtain a generalized quantitative criterion to classify the rate controlling mechanism; i.e., liquid inertia, heat transfer, or both. The equations governing spherically symmetric vapor bubble growth in an infinite medium are first formulated. Two approximate solutions to the energy equation giving bubble interface temperature as a function of bubble radius were utilized. These were the Plesset-Zwick zero order approximation and a solution based on an integral technique due to Murdock. The governing equations, retaining both liquid inertial and heat transfer effects, were nondimensionalized in such a way that the solutions for dimensionless bubble interface displacement as a function of dimensionless time depend only on the initial dimensionless radius, the vapor pressure and density relations for the fluid, and the system pressure variation. Dissert. Abstr.

N70-24534 Kansas State Univ., Manhatten.
THERMAL TRANSPORT BETWEEN NON-LAMBERT SURFACES
Darrol Holt Timmons (Ph.D. Thesis) 1969 193 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-21146

The effect of non-Lambert boundary reflection on the mutual interaction between the processes of radiative and conductive heat transfer is studied analytically. The analysis is restricted to isothermal, infinite, parallel plane surfaces separated by an absorbing, emitting, and scattering gray medium with finite thermal conductivity. Both isotropic and anisotropic scattering media are considered. For a pure scattering medium the equations of transfer are linear and the solution is obtained by standard linear boundary-valve methods. With absorption the formulation is a nonlinear boundary-value problem which is solved numerically by the technique of quasilinearization. A linearized version of the governing equations is solved in order to obtain the initial approximation required for the quasilinearization algorithm. Dissert. Abstr.

N70-24542 Arizona Univ., Tucson.
INTERNAL LAMINAR HEAT TRANSFER TO A GAS WITH TEMPERATURE DEPENDENT PROPERTIES
Thomas Burke Swearingen (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-19886

The results of an analytical and experimental investigation of internal laminar heat transfer to a gas with temperature dependent properties is reported. The analytical investigation obtains numerical solutions for the differential equations of energy, momentum, and continuity describing the laminar flow of an ideal gas between heated parallel plates. This analysis is conducted primarily for constant wall heat flux, equal on both plates, and a fully developed velocity profile at the start of the heated section. The gas is assumed to be an ideal gas with temperature-dependent transport properties, density, and specific heat. For this analysis the transport properties and specific heats are assumed to follow power law variations; exponents approximating those for air and helium are considered. Dissert. Abstr.

N70-24553# Sud-Aviation, Paris (France).
THEORETICAL PARAMETERS AND EXPERIMENTAL DETERMINATIONS IN THE STUDY OF MATERIAL SUBJECTED TO ABLATION [PARAMETRES THEORIQUES ET DETERMINATIONS EXPERIMENTALES DANS L'ETUDE DE MATERIAUX SOUMIS A L'ABLATION]
E. Guerini and R. Joatton *In* AGARD Reactions Between Gases and Solids Feb. 1970 refs In FRENCH (See N70-24551 11-06)
Avail: CFSTI

The behavior of ablative materials and representative calculations for the thermal conductivity are considered. Tentative calculations for heat shields were based on a simplified equation. Two parameters were obtained for the transformation of materials for which the Fourier equation was used. Mass variations were considered in relation to the temperature distribution. Transl. by J.M.C.

N70-24555# Rouen Univ. (France). Faculte des Sciences.
TRANSFER OF HEAT AND MATTER AT THE TOP OF A CATALYTIC SURFACE IN A TURBULENT FLOW [TRANSFERT DE CHALEUR ET DE MATIERE AU DESSUS D'UNE SURFACE CATALYTIQUE DANS UN ECOULEMENT TURBULENT]
M. Trinite et P. Valentin *In* AGARD Reactions Between Gases and Solids Feb. 1970 13 p refs In FRENCH (See N70-24551 11-06)
Avail: CFSTI

The simultaneous transfer of heat and matter is considered with emphasis on the regularity viscosity, conductivity, and turbulent diffusion. The example of a catalytic surface of hydrogen in a turbulent boundary layer at the top of a flat plate is used. Boundary layer conditions are defined and the lux differences are calculated. Experimental values for the conductivity and the turbulent diffusion were not in agreement with the exact discontinuity and Lewis number. Transl. by J.M.C.

N70-24567# Princeton Univ., N.J.
A REVIEW OF METAL IGNITION AND FLAME MODELS
I. Glassman, A. M. Mellor, H. F. Sullivan, and N. M. Laurendeau *In* AGARD Reactions between Gases and Solids Feb. 1970 41 p refs (See N70-24551 11-06)
Avail: CFSTI

A physical model of the heterogeneous ignition process of metals was developed. This model is compared with other theories of metal ignition concerned with bulk samples, quiescent piles, single particles and dust dispersions. The new model is based upon the concept of a transition temperature – the temperature at which the oxide layer on the metal becomes non-protective in the sense that a reaction rate independent of time describes the behavior of the system at constant temperature. The model postulates that the ignition temperature must be greater than both the transition and the critical temperatures. It further relates pyrophoricity to the concept of a transition temperature. The transition temperature thought to be a unique value characteristic to the metal, such as the oxide melting point, has been shown by Kuehl to be pressure dependent in the case of aluminum. Kuehl's work and the recent supporting evidence of Laurendeau on zinc are reviewed. With respect to the burning mechanisms of metals, reviewed are the finite reaction zone model of Coffin, liquid oxide bubble model of Fassell, collapsed reaction zone model of Brzustowski and Glassman, extension of the Brzustowski-Glaseman model by Knipe, the heterogeneous reaction model of Markstein and the very recent, broad homogeneous reaction zone model of Sullivan. Author

N70-24568# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
RECENT EXPERIMENTAL RESULTS ON THE COMBUSTION OF ALUMINUM AND OTHER METALS [RESULTATS EXPERIMENTAUX RECENTS SUR LA COMBUSTION DE L'ALUMINIUM ET D'AUTRES METAUX]
Marcel Barrere *In* AGARD Reactions Between Gases and Solids Feb. 1970 18 p refs In FRENCH; ENGLISH summary (See N70-24551 11-06) Avail: CFSTI

The study of the combustion of metals has recently become important since they are not used as a fuel in modern rocket propulsion systems. The ignition delay and burning time of metal particles, the combustion efficiency as well as the nature of the combustion products are the most important points. The first part is devoted to the experimental techniques used for the study of metal combustion. Two main groups of techniques are defined. One concerning metal particle combustion, the other concerning the combustion of metal wires. The second part is a synthesis of the experimental results showing for each metal and in particular for aluminum, beryllium, magnesium and boron. From these results some combustion models are proposed and are dealt with in the third part. Author

N70-24569# Northern Research and Engineering Corp., London (England).
COMBUSTION OF SOLID PARTICLES IN A TURBULENT STREAM WITH RECIRCULATION
M. M. Gibson and B. B. Morgan (BCURA Ind. Labs., Leatherhead, Engl.) *In* AGARD Reactions Between Gases and Solids Feb. 1970 17 p refs (See N70-24551 11-06)
Avail: CFSTI

The paper describes a calculation procedure used to predict mass, momentum and energy transfer in a turbulent pulverised-coal flame in a cylindrical chamber, the geometry of which produces a zone of recirculatory flow. The flame, which may be swirling, is axisymmetric. The elliptic partial-differential equations describing the flame are solved numerically at a finitie number of points in the flow field. The procedure includes a simple model of thermal radiation which assumes that net transfer along the length of the flame is zero. Results of calculation are compared with data from six flames that differ in respect of burner size, fuel fineness and input swirl. Prediction is fairly good for the non-swirling flames but is less satisfactory for swirling ones. Possible improvement to the calculation procedure are outlined. Author

N70-24570# Office National d'Etudes et de Recherches Aerospatial, Paris (France).
FUSION PHENOMENA AND SURFACE REACTIONS IN THE COMBUSTION OF LITHERGOLS [PHENOMENES DE FUSION ET REACTIONS DE SURFACE DANS LA COMBUSTION DES LITHERGOLS]
Jean-Francois Lieberherr *In* AGARD Reactions Between Gases and Solids Feb. 1970 16 p refs In FRENCH; ENGLISH summary (See N70-24551 11-06)
Avail: CFSTI

The first models used in hybrid combustion studies were based upon heat transfer from a gas to an evaporating or subliming solid. Many disagreements between experiment and these simplified models have led to think that other mechanisms are involved. The possibility of a chemical surface reaction was rapidly considered, this reaction taking place at the surface or very close to it. Various models have thus been established and account reasonably for the experimental observations, except for those observed at ONERA on high regression rate hybrid fuels and on metallic hydrides. Although the surface reactions remain as an important mechanism the theoretical study presented here shows that they must not be connected to a simple vaporization model but to a melting mechanism, and to the subsequent liquid flow. Author

N70-24639# Eidgenossische Technische Hochschule, Zurich (Switzerland).
EDDY VISCOSITY AND EDDY CONDUCTIVITY: A STATISTICAL APPROACH AND EXPERIMENTAL VERIFICATION
Frederick Davies (Ph.D. Thesis) 1969 166 p refs *Its* Dissertation No. 4107
Avail: CFSTI

The relationship between heat and momentum transport, expressed by the eddy conductivity and eddy viscosity has been determined. This has been accomplished theoretically by integrating the probability that a fluid lump travels from one point in the fluid to another. The ratio of the eddy conductivity to the eddy viscosity has been calculated for fluids with a Prandtl Number from 0.001 to 1000. These results have been used to predict theoretical Nusselt Numbers and temperature profiles. The results have been verified experimentally for water using a new type of instrument to measure the velocity and temperature fluctuations. Author

N70-24658# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
SUPERSONIC COMBUSTION STUDIES AT LOW DENSITY CONDITIONS
James E. Drewry, Robert G. Dunn, and Norman E. Scaggs Sep. 1969 19 p refs Presented at the AIAA 5th Propulsion Joint Specialist Conf., Boulder, Colo., 9-13 Jun. 1969
(AD-699206; ARL-69-0159) Avail: CFSTI CSCL 21/2

An investigation of supersonic combustion as related to propulsive systems for high Mach number, high altitude flight is described. A method of laboratory simulation is employed which is considered to be suitable for fundamental studies of diffusional-controlled supersonic combustion under conditions approaching those of actual flight. A numerical analysis of the mixing and combustion processes for an axisymmetric hydrogen-air ducted flow system was carried out, using a computer code based upon boundary layer concepts and including the effects of finite-rate chemistry. A limited parametric study of the combustor flow field was made for a Mach number range of 1.5 to 2.5 for the injected air stream. Hydrogen injection is central and parallel to the air stream and is assumed to occur sonically. A matched pressure condition between the fuel and air streams is assumed to exist at the combustor inlet. Inlet static pressures in the range of 0.1 to 0.2 atmospheres were considered. Results of the parametric study indicated the inlet conditions required to achieve auto-ignition within a reasonable combustor length. Based on the numerical data obtained, a mixing and combustion chamber was designed and fabricated for the performance of experimental tests under conditions closely matching those of the numerical study. Experimental data from a number of laboratory tests in which supersonic combustion was obtained are presented and discussed. Author (TAB)

N70-24695# Eidgenossische Technische Hochschule, Zurich (Switzerland).
WIND TUNNEL EXPERIMENTS AND THEORETICAL ASPECTS OF LOCAL HEAT AND MASS TRANSFER ON HAILSTONE MODELS [WINDKANALVERSUCHE UND THEORETISCHE BETRHCHTUNGEN ZUM LOKALEN WAERME- UND STOFFUEBERGANG AN HAGELKORNMODELLEN]
Armin Niklaus Aufdermaur (Ph.D. Theiss) 1968 70 p refs In GERMAN
(Diss-4221) Avail: CFSTI

The theory of heat transfer during growth of hailstones was supported in wind tunnel investigations and used for quantitative calculations of local convective heat transfer. Experiments were performed on a smooth sphere, a rough sphere, and a buckled hailstone model at Reynolds numbers from 4100 to 68 000 and at flow turbulence between 0.2 and 5 percent. Observed were isothermal surface temperatures and convective exchange of water

vapor in laminar two-dimensional or rotation symmetrical boundary layers. Results showed that the heat transfer in the laminar boundary layer was about 10 to 15 percent greater than theoretical predicted; this effect was attributed to wind tunnel turbulence. Heat transfer at different locations of the isothermal surface showed variations of almost one order of magnitude. . Transl. by G.G.

N70-24738# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
THE INFLUENCE OF GRAVITY ON HEAT TRANSFER IN HEAT PIPES [SCHWERKRAFTEINFLUSS AUF DEN WAERMETRANSPORT IN WAERMEROHREN]
L. Reichle 1969 22 p refs In GERMAN Presented at the DGLR Ann. Meeting, Bremen, 22-24 Sep. 1969
Avail: CFSTI

The influence of gravity on the fluid flow in heat pipes installed in satellites is discussed. The maximum heat flow in a heat pipe and the influence of variable gravity forces are calculated. ESRO

N70-24754# Entwicklungsring Nord, Bremen (West Germany).
THE THERMAL LOAD OF AN AERODYNAMIC REENTRY BODY AND THE RESULTING OPTIMIZATION AND INTERPRETATION CRITERIA [DIE THERMISCHE BELASTUNG EINES AERODYNAMISCHEN WIEDEREINTRITTSKOERPERS UND DIE DARAUS RESULTIERENDEN OPTIMIERUNGS- UND AUSLEGUNGSKRITERIEN]
W. F. Zimni, J. P. Hoffmann, and E. A. Raetz 1969 30 p refs In GERMAN Presented at the DGLR Ann. Meeting, 22-24 Sep 1969
Avail: CFSTI

After a description of the physical process of aerodynamic heating, computation methods for determining the heat transfer of a reentry body are sketched. Using the reentry vehicle LB 10 as an example, a method for the approximate analytical determination of complex geometrical forms for reentry bodies is described. ESRO

N70-24834# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE EXPERIMENT THERMAL DESIGN
M. Schach *In* Univ. Coll., London Prelim. Design of a Cosmic X-ray Survey Expt. Oct. 1969 p 61-71 (See N70-24826 11-30)
Avail: CFSTI

The estimation of maximum and minimum temperatures and temperature gradients in spacecraft components, subsystems etc. are discussed together with the use of thermal control coatings, multilayer insulation and thermomechanical devices such as louvers and heat pipes. The thermal analysis of experiments in terms of thermal modes and instantaneous power balances is considered in detail. Thermal simulation procedures are also outlined. ESRO

N70-24895*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
SUMMARY OF COMBUSTION INSTABILITY RESEARCH AT PRINCETON UNIVERSITY, 1969
L. Crocco, D. T. Harrje, W. A. Sirignano, F. V. Bracco, A. P. Chervinsky et al Feb. 1970 87 p refs
(Grant NGL-31-001-155)
(NASA-CR-72680; AMS-T-903) Avail: CFSTI CSCL 20M

Eight studies on the control and cause of combustion instability in rocket combustors are reported; (1) acoustic liner theory, (2) theoretical study of quarter-wave tubes, (3) oscillatory droplet wake diffusion flames, (4) combustion response to step-shock waves, (5) unsteady thermal behavior of the liquid droplet, (6) improved mathematical techniques for nonlinear oscillations, (7) chemical kinetic effects and (8) hydrogenation rocket feasibility study. Each is extensively abstracted with regard to recent results and progress. Author

N70-24987 Arizona State Univ., Tempe.
A STUDY OF THE MECHANISM OF IGNITION TRANSFER IN A FUEL DROPLET ARRAY
Roger Norman Anderson (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-20750

An experimental and analytical study of the mechanism of ignition transfer in a fuel droplet array is presented. A row of heptane or hexane fuel droplets suspended on steel needles was ignited at a prescribed time (existence time) after formation. The flame propagation down the array was photographed with a high speed motion picture camera. The time interval between ignition of adjacent fuel droplets was obtained by analyzing the film and this time was recorded as a function of droplet size, droplet center spacing, and existence time. It was found that there were two definite modes of ignition transfer. The fast mode was termed droplet ignition; the slow mode was termed pool ignition. The velocity of propagation of droplet ignition was on the order of 5 times the propagation velocity of pool ignition. The mode of ignition transfer which occurred depended on the existence time and the droplet spacing. A longer existence time favored pool ignition, a closer spacing favored droplet ignition. Dissert. Abst.

N70-25013# Eidgenossische Technische Hochschule, Zurich (Switzerland).
CONTRIBUTION TO THE CALCULATION OF THERMODYNAMIC INTERACTION BETWEEN COMBUSTION ENGINE AND EXHAUST-DRIVEN SUPERCHARGER [BEITRHG ZUR BERECHNUNG DES THERMODYNAMISCHEN ZUSAMMENWIRKENS VON VERBRENNUNGSMOTOR UND ABGASTURBOLADER]
Meinrad Eberle (Ph.D. Thesis) 1968 138 p refs In GERMAN /ts Diss. No. 4220
Avail: CFSTI

Thermodynamic calculations for combustion engine systems consider the combined effect of combustion engine, hydraulic pump and exhaust turbosupercharger. Emphasis is placed on properties of the two stroke Diesel engine that very often is regarded as a system of coupled containers. The basic principles of heat transfer in engine cylinders are discussed together with boundary conditions, heat development laws, and gas exchange. Effects of some important parameters on the behavior of exhaust-driven two-stroke Diesel engines as well as its operational performance are studied in accordance with the propeller law. Also considered are some problems in digital computer programming. Transl. by G.G.

N70-25042 West Virginia Univ., Morgantown.
A LINEARIZED THEORY OF HEAT CONDUCTION FOR RIGID MATERIALS WITH MEMORY
Jace W. Nunziato (Ph.D. Thesis) 1969 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-20712

Emphasis in this study is placed upon a linearized theory of heat conduction; that is, a theory based on thermodynamic processes for which the thermal history is always close to a known equilibrium history. Several aspects of this theory are discussed including the requirements of material symmetry. In addition, the thermodynamic restrictions on this theory resulting from the previous nonlinear analysis and the consideration of some special processes such as processes involving step histories, very slow processes, and very fast processes are deduced. As a direct consequence of this analysis, it is shown that under certain circumstances, very fast processes are adiabatic. To illustrate the theory developed, two boundary value problems are considered; the propagation of plane progressive waves in a semi-infinite body and the sudden

temperature rise on a finite rod. For the first problem, explicit equations for the wave speed and attenuation are derived as functions of frequency; and using asymptotic expansions, it is shown that for low frequencies, the linearized theory and the classical theory coalesce. Similarly, asymptotic expansions are employed to analyze the speed and attenuation for large frequencies with the result that if a certain material parameter is non-zero, then the speed and attenuation for large frequencies with the result that if a certain material parameter is non-zero, then the speed and attenuation are unbounded as in the classical theory; if this material parameter is zero, then the speed and attenuation remain finite for arbitrarily large values of frequency. The rod problem is included simply to indicate that a separation of variables technique may be employed to solve such problems. Dissert. Abstr.

N70-25107# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.
IMPINGEMENT COOLING
T. S. Keeble Aug. 1969 22 p refs
(ARL/ME-308) Avail: CFSTI

A review is made of data available on heat transfer caused by a jet or array of jets impinging perpendicularly on a surface. A short description is given of the flow in turbulent and laminar air jets impinging on a wall with particular reference to the entrainment of air into the jet. It is concluded that further work on impingement cooling is required if optimal arrays are to be designed. It is also considered that measurements should be made in a laminar air jet for correlation with theory particularly as far as the distance of the theoretical origin from the nozzle discharge is concerned. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-23921# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
ENGINEERING MATERIALS LIST
Richard J. Smith, Francis L. Sachs, and Willie E. Clark, eds. Dec. 1969 48 p refs
(TID-4100-Suppl-55) Avail: US AEC Div. of Tech. Inform. Extension, P. O. Box 62, Oak Ridge, Tenn. 37830

Twenty-four packages of engineering drawings and specifications are presented. Packages of drawings are included on a free-surface type centrifugal pump, hydrostatic pressure cell, calibration facility, omni-directional vacuum gage probe, terminal and relay blocks, low temperature stage for Picker theta-theta x-ray diffractometer, open end ratchet wrench, 2X-vacuum system, cryogenic system for Baseball II magnet, minimum ionization particle detector, gamma radiation monitoring system, ultrasonic incipient boiling detector, Astron 1.4 meter magnet, automatic gas delivery system, precision staircase calibrator, EPUT multiplexer coder and driver and decoder, spectrophotometer glove box, complementary pair feedback amplifier, trisonic wind tunnel, vibrating sample magnetometer, vertical assembler diamantier, Rossi injection box, and dual-cell assembly for high-temperature mass spectrometer calibration. A subject index is included. NSA

N70-23924*# Indian National Scientific Documentation Centre, New Delhi.
SPACE LAW
G. P. Zhukov 1969 299 p refs Transl. into ENGLISH of the book "Kosmicheskoe Pravo" Moscow, Mezhdunarodnye Otnosheniya, 1966 Sponsored by NASA
(Contract NSF C-466)
(NASA-TT-F-517; TT-68-50636) Copyright. Avail: CFSTI CSCL 05D

The development of the science of space law is advocated and its aim to study the various legal problems arising in connection with space exploration is outlined. A law regulating space activities may help prevent biological, radioactive, and chemical contamination of outer space and the earth from space. Of great importance is also the prevention of space obstruction with objects which have lost scientific and practical importance. Although there is little probability for a spaceship collision with junked objects, necessary legal measures have to be formed to deal with the problem when it arises. Radio communication from space orbiting objects should also be regulated to insure radio contacts of space astronauts on future missions. G.G.

N70-23996# Office of Aerospace Research, Arlington, Va.
[REPORT OF OAR'S FISCAL YEAR FOR 1969] Progress Report
Jacob Seiden Nov. 1969 165 p refs
(AD-699300; OAR-69-0017) Avail: CFSTI CSCL 5/1

The report covers the various aspects of management, including finances, manpower, logistics, research information activities, and planning, and highlights some OAR achievements in the defense research sciences, exploratory development, and advanced development. A bibliography is included to aid readers in obtaining detailed information on the research programs described. Author (TAB)

N70-24009*# Pittsburgh Univ., Pa. Knowledge Availability Systems Center.
DEVELOPMENT OF A CAMPUS BASED INFORMATION SYSTEM WITH INITIAL EMPHASIS ON CHEMISTRY Quarterly Reports, 1 Sep. 1969 - 1 Mar. 1970
Allen Kent Mar. 1970 37 p
(Contract NSR-39-011-105)
(NASA-CR-109458; QR-1-2) Avail: CFSTI CSCL 05B

As an integral part of the NASA information dissemination network, the Chemical Abstracts Service Chemical Condensates (CASCON) file is the Knowledge Availability Systems Center's (KASC) responsibility in the network. General highlights of KASC's operations are discussed and its progress in meeting the milestone schedule is reported. Information is included concerning CASCON's standard format distribution tape, KASC's plans for building a retrospective CASCON file, KASC's reference retrieval program, and KASC's fee schedule research. D.L.G.

N70-24039# Resources Management Corp., Inc., Bethesda, Md.
THE POTENTIAL TRANSPORTATION BENEFITS OF IMPROVED ENVIRONMENTAL PREDICTION
12 Dec. 1969 188 p refs
(Contract DOT-CG-92463-A)
(AD-699205; RMC-UR-099) Avail: CFSTI CSCL 13/6

Contents: Environmental predictability; Measuring predictive performance; Measuring economic benefits: (Sample approach to measuring direct benefits, Benefit concepts and assumptions, Other benefit considerations); Air transportation: (General aviation accidents, Air carrier delays, Cancellations, Diversions); Ground transportation: Snowstorms in metropolitan areas; Marine transportation: Reducing vessel transit time; Preventing vessel damage and loss; Preventing cargo damage and loss; Ice operations; Reducing fatalities; Increasing passenger comfort; and Improving port services. TAB

N70-24039# Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.

REPORT TO THE JOINT SERVICES TECHNICAL ADVISORY COMMITTEE Progress Report, 15 Sep. 1968 – 14 Sep. 1969

Arthur A. Oliner Nov. 1969 440 p refs

(Contracts AF 49(638)-1402; F44620-69-C-0047)

(AD-698361; PIBMRI-R-452.34-69; AFOSR-69-2755TR; PR-34) Avail: CFSTI CSCL 20/14

The program covers a broad spectrum ranging from basic theoretical physics, mathematics, and engineering, to experimental investigations involving basic measurements, development of devices, and materials. The report is compiled under seven headings: Electromagnetics and Waveguide Techniques; Quantum Electronics and Optics; Plasma Physics and Electronics; Solid State and Materials; Control Theory and Computer Science; Communications and Information Processing; Networks and Systems. TAB

N70-24051# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.

PROJECT SQUID Semi-annual Progress Report

I. E. Alber, J. B. Anderson, J. A. Fay, J. B. F. Fenn, and A. Ontijn 1 Jan. 1969 77 p refs

(Contract N00014-67-A-0226-0005)

(AD-698541) Avail: CFSTI CSCL 21/2

Report of progress on 13 of the 14 research programs comprising Project SQUID are presented. The research programs fall into the areas of fluid mechanics and MHD, atomic and molecular collisions, combustion and chemical rate processes, and chemi-ionization and ion-molecular reactions. Project SQUID is a cooperative program of basic research related to jet propulsion. Author (TAB)

N70-24065*# Miami Univ., Coral Gables, Fla. Center for Advanced International Studies.

NASA INFORMATION RESOURCES FOR THE FEEDBACK PROCESS

Dodd L. Harvey and Karen M. Bartol 14 Nov. 1969 110 p refs

(Contract NSR-10-007-078)

(NASA-CR-109453) Avail: CFSTI CSCL 05A

A means to permit ready access to the massive amount of inhouse data available at NASA headquarters, which is useful in explaining, understanding and evaluating the impact of NASA programs on the external environment is reported. The explanation is a mixture of reports, files, and collections of documents, and the format for the source description consists of: title, nature and purpose, and the office or individual to contact for additional information. Some source descriptions included are congressional reports, congressional responses, budget estimates, space age management, and financial high light reports. F.O.S.

N70-24077# National Bureau of Standards, Washington, D.C.

TECHNICAL HIGHLIGHTS OF THE NATIONAL BUREAU OF STANDARDS Annual Report, 1969

Mar. 1970 243 p refs

(NBS-SPEC-PUBL-325) Avail: SOD $1.25

The activities of the research institutes and centers are discussed. Staff and organizational changes and programs affecting national policy and consumer problems are described, and include the reorganization of the Center for Computer Science and Technology, advanced research teamwork with universities, progress in equal employment opportunities, and transfer of the Test Development Division. Continuing research is summarized for the Institute for Basic Standards, Institute for Materials Research, Institute for Applied Technology, and Center for Radiation Research. Publications and patents are also listed. N.E.N.

N70-24092*# Syracuse Univ., N.Y.

MULTIDISCIPLINARY STUDIES IN MANAGEMENT AND DEVELOPMENT PROGRAMS IN THE PUBLIC SECTOR Semiannual Report, 1 Jul. – 31 Dec. 1969

Martin E. Barzelay Mar. 1970 40 p refs

(Grant NGL-33-022-090)

(NASA-CR-109454; SAR-4) Avail: CFSTI CSCL 05A

Continuing research activities on project management, business relations, decision making, multidisciplinary research, and related topics are reported, and abstracted data from reports are given. Efforts on the role of the project manager are centered on correlating information and insights, and conferences and trips for the purpose of establishing research models and conclusions are summarized. Dissemination of new technology in institutions, large manufacturing firms, and nuclear power plants is discussed. Additional research is outlined on space regulations; partitioning NASA contracts; NASA and multidisciplinary research in universities; public administration in the universities, and NASA; the accuracy of cost estimation for Apollo decision making; and the international tracking system. N.E.

N70-24240# Stanford Univ., Calif. Center for Materials Research.

MATERIALS RESEARCH AT STANFORD UNIVERSITY Annual Report, 1 Jul. 1968 – 30 Jun. 1969

Nov. 1969 243 p refs

(AD-698535; AR-8) Avail: CFSTI CSCL 11/7

The report contains brief descriptions of the various individual research programs active during the period July 1968 through June 1969, arranged alphabetically by the name of the principal investigator. Also included are lists of publications, doctoral dissertations, faculty and senior staff members, research associates, graduate students and degrees awarded. Finally, a name index is included for convenience in locating references to the activities of specific individuals. Author (TAB)

N70-24281# Lincoln Lab., Mass. Inst. of Tech., Lexington. Electronic Systems Div.

GENERAL RESEARCH Quarterly Technical Summary Report, 1 Aug. – 31 Oct. 1969

Frederick C. Frick, Robert H. Kinston, Alan L. Mc Whorter, Herbert G. Weiss, and John F. Hutzenlaub 15 Nov. 1969 49 p

(Contract AF 19(628)-5167)

(AD-699254; ESD-TR-69-335) Avail: CFSTI CSCL 17/9

This Quarterly Technical Summary covers the period from 1 August through 31 October 1969. It consolidates the reports of Division 2 (Data Systems), Division 4 (Radar), Division 5 (Optics), Division 7 (Engineering), and Division 8 (Solid State) on the General Research Program at Lincoln Laboratory. Author (TAB)

N70-24402# Defence Research Board, Ottawa (Ontario). Defence Scientific Information Service.

AN ANNOTATED BIBLIOGRAPHY OF UNCLASSIFIED REPORTS ISSUED BY DEFENCE RESEARCH NORTHERN LABORATORY, 1947 – 1965

G. K. Davies, comp. Dec. 1969 75 p refs

(DSIS-B-13; PD-9586) Avail: CFSTI

A bibliography of reports held in the Defense Research Scientific Information Service, and issued from 1947 to 1965 is presented. Subjects are trouped under physical sciences, biological sciences, and operational research. F.O.S.

N70-24495# Northwestern Univ., Evanston, Ill. Materials Research Center.

[A CONDENSED ACCOUNT OF THE RESEARCH ACTIVITIES OF ALL MEMBERS OF THE MATERIALS RESEARCH CENTER AT NORTHWESTERN] Annual Report, 1 Oct. 1968 – 30 Sep. 1969

1969 202 p refs

(Contract ARPA SD-67)

(AD-699495; AR-10) Avail: CFSTI CSCL 11/7

The document is an Annual Report for 1969 and gives a condensed account of the research activities of all members of the

Materials Research Center at Northwestern University. Presented herein are the summaries of research progress prepared by the individual faculty members; and these are arranged in alphabetical order by author, and include a list of invited talks and publications stemming from the research and the names of postdoctoral research associates and graduate students affiliated with each project. Author (TAB)

N70-24649*# Rensselaer Polytechnic Inst., Troy, N.Y.
MATERIALS RESEARCH Semiannual Progress Report
Mar. 1970 84 p refs
(Grant NGL-33-018-003)
(NASA-CR-109479) Avail: CFSTI CSCL 11G

CONTENTS:

1. STRUCTURAL CHARACTERIZATION p 3-27 refs (See N70-24650 11-06)
2. SOLID STATE REACTIONS AND PHASE TRANSFORMATIONS p 28-38 (See N70-24651 11-06)
3. MECHANICAL PROPERTIES AND STRENGTHENING MECHANISMS p 39-57 ref (See N70-24652 11-17)
4. ELECTRONIC AND PHYSICAL PROPERTIES OF MATERIALS p 58-69 (See N70-24653 11-18)

N70-24725# Congress. House. Committee on Science and Astronautics.
AERONAUTICAL RESEARCH
Washington GPO 1970 404 p refs Hearings before the Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., 1-2 Dec., 4 Dec., and 8-11 Dec. 1969
Avail: Subcomm. on Advan. Res. and Technol.

Statements from 1 December 1969 to 11 December 1969 made before the Subcommittee on advanced research and technology, concerning the priorities needed in aeronautical research to strengthen the entire area of aeronautics are recorded. Included are the following topics: (1) civil aviation use of V/STOL aircraft, (2) federal research and development programs, (3) research and development related to U.S. military and commercial aircraft, and (4) NASA's view of aeronautical research and development. F.O.S.

N70-24792# Joint Publications Research Service, Washington, D.C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 221
2 Feb. 1970 158 p refs Transl. into ENGLISH from Russian publications
(JPRS-49739) Avail: CFSTI

CONTENTS:

1. ASTRONOMY p 1-5 refs (See N70-24793 11-30)
2. METEOROLOGY p 6-55 refs (See N70-24794 11-20)
3. OCEANOGRAPHY p 56-73 refs (See N70-24795 11-13)
4. TERRESTRIAL GEOPHYSICS p 74-90 refs (See N70-24796 11-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 91-140 refs (See N70-24797 11-29)

N70-24921*# IIT Research Inst., Chicago, Ill.
TECHNOLOGY APPLICATIONS TEAM Quarterly Progress Report, 1 Oct. -31 Dec. 1969
31 Dec. 1969 54 p refs
(Contract NASw-1953; IITRI Proj. V6102)
(NASA-CR-109499) Avail: CFSTI CSCL 05B

Public sector contacts, literature search efforts, and technology identification activities are reviewed, emphasizing law enforcement and mine safety technology. Technology transfer problem statements are given on: quenching of coal mine explosions, mine rescue communications, detection and recovery of indented writing, vehicular speed determination, and age and sequence of ball pen writing on documents with multiple entries. Literature searches were begun on the following problems: dust monitoring in coal mines; detection for automatic quenching of coal mine explosions; and measurement of air flow velocities in coal mine passages. S.S.

N70-24989 Georgia Inst. of Tech., Atlanta.
FIXED ASSET REPLACEMENTS AND ACQUISITIONS IN A TYPICAL FIRM IN THE AEROSPACE INDUSTRY
Kurt Askin (Ph.D. Thesis) 1969 252 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 69-19644

The purpose of this study is to set forth those factors that influence decisions concerning the replacement and acquisition of machinery and equipment, as these decisions are made in a typical firm in the aerospace industry. Models for these decision-making processes are developed and solution procedures are established. The objectives of this research are: (1) definition of significant factors affecting fixed asset decisions facing a typical firm in the aerospace industry, (2) the development of realistic models in the relatively unique environment of an aerospace industry, and (3) the establishment of solution procedures for optimizing the criteria of effectiveness, subject to various constraints and period linking requirements. The present decision-making process concerning fixed asset investments as it occurs in TASCO, a typical aerospace firm, is presented to provide a realistic background for the proposed models. Also presented are discussions of centralization and decentralization of decisions at TASCO, relations with government, and the details of the planning and budgeting of fixed asset acquisitions. Dissert. Abstr.

N70-25016# Congress. House. Committee on Foreign Affairs.
SATELLITE BROADCASTING: IMPLICATIONS FOR FOREIGN POLICY
Washington GPO 1969 324 p refs Hearings before Comm. on Foreign Affairs, 91st Congr., 1st Sess., 13-15 May and 22 May 1969
Avail: Subcomm. on Natl. Security Policy and Sci. Develop.

Hearings were held to discuss U.S. policies and performance in the international use of satellite broadcasting and to secure direction and coordination in the political, social, economical, legal, educational, and cultural aspects of direct broadcasting. Committee recommendations include: (1) requests for broadcast satellites should be referred to Intelsat, which would procure and place satellites in orbit, provide backup satellites, and operate telemetry, control, and programming; (2) the United Nations should be given free use of Intelsat facilities for its peacekeeping, operational, and informational requirements; (3) a developmental television center should be established, preferably within the Agency for International Development, to plan and implement projects for educational purposes in less developed countries; and (4) in order to better coordinate U.S. telecommunications policy, the Office of Telecommunications Management within the Executive Office should be upgraded. S.S.

N70-25049# Congress. House. Committee on Science and Astronautics.
TECHNOLOGY ASSESSMENT
1970 GPO 1970 508 p refs Hearings before the Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., No. 13, 18, Nov. 2, 3-4, 8, and 12 Dec. 1969
Avail: Subcomm. on Sci., Res. and Develop.

Statements from 18 November 1969 to 12 December 1969 made before the subcommittee on science, research, and development, concerning technology assessment and the manner in which it can be accomplished are recorded. Included are comments

on the following topics: food additives, DDT contamination, and assessment projects being processed by the Reference Service of the Library of Congress. A bibliography of the witnesses is also included. F.O.S.

N70-25063# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1971, PART 1
Washington GPO 1970 588 p Hearings on S 3374 before Comm. on Aeron. and Space Sci., 91st Congr., 2d Sess., 20, 27 Feb. and 4 Mar. 1970
Avail: Comm. on Aeron. and Space Sci.

Statements made before the Congressional Committee on Aeronautical and Space Sciences from 20 February 1970 to 4 March 1970, concerning S. 3374 are recorded. The bill for NASA appropriations included the research and development for the following programs: (1) Apollo, (2) space flight operation, (3) launch vehicle procurement, (4) nuclear rockets, (5) tracking and data acquisition, and (6) human factor systems. F.O.S.

N70-25075# Royal Aircraft Establishment, Farnborough (England).
DEFENCE RESEARCH ABSTRACTS [FOERSVARS FORSKNINGS REFERAT]
Jan. 1970 43 p
(RAE-LIB-TRANS-1392) Avail: CFSTI

This volume covers the third quarter of 1969. The main topics covered are: studies (system analyses), nuclear reactions, chemical and biological warfare, conventional warfare, applied physics, teletechniques, biotechnology, military psychology and psychological defense. Author

N70-25095# Congress. House. Committee on Science and Astronautics.
MANNED SPACE FLIGHT: PRESENT AND FUTURE
James E. Wilson and Harold A. Gould Washington GPO 1970 397 Presented to the Comm. on Sci. and Astronautics, 91st Congress, 2d Sess., 12 Feb. 1970 *Its* Serial K
Avail: Subcomm. on NASA Oversight

Summaries are presented of conferences with NASA headquarters, field centers, and aerospace industrial contractors highlighting the following: (1) Without major decisions on a manned space flight program, the United States will possess no manned space flight capability beyond 1974; (2) The decline in national technological and scientific facilities and personnel has reached a level which could if continued risk accomplishment of current programs; (3) A launch rate of less than two manned vehicles per year could materially increase the risk in manned launch and spaceflight operations; (4) In the case of the Apollo launch and spacecraft, it appears that a fabrication rate of two or more per year would minimize annual cost while maintaining the critical skills of major and subcontractor personnel; (5) Without a decision to extend the orbital workshop program or initiate development of a space station, the United States will have no long duration (28 to 56 days) capability after 1973; (6) For a low cost earth-to-orbit recoverable transportation system, a chemical space tug should be developed. S.S.

N70-25120# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION, 1971, VOLUME 1
Washington GPO 1970 943 p Hearings on H.R. 15695 before Comm. on Sci. and Astronaut., 91st Congr., 2d Sess., No. 16, 17 Feb., 19-20 Feb., and 24-26 Feb. 1970
Avail: Comm. on Sci. and Astronaut.

Hearings on manned space flight are presented, emphasizing the Apollo Program and the Apollo Applications Program. Space stations and space shuttles are also discussed. Briefings and field hearings on contractors and summaries of centers' activities are also presented. N.E.N.

N70-25121# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION, 1971, VOLUME 2
Washington GPO 1970 956 p Hearings on H.R. 15695 before Comm. on Sci. and Astronaut., 91st Congr., 2d Sess., No. 16, 17 Feb., 19-20 Feb., and 24-26 Feb. 1970
Avail: Comm. on Sci. and Astronaut.

Statements on the scientific and technological programs of the unmanned space flight, and advanced aircraft and space shuttle developments are presented. Interplanetary flights and scientific earth orbit flights are discussed, along with ground support operations and propulsion and power systems. N.E.N.

N70-25153# European Space Research Organization, Paris (France).
ESRO/ELDO BULLETIN, NO. 8
Jan. 1970 28 p refs Partly in ENGLISH and partly in FRENCH Prepared jointly with ELDO
Avail: CFSTI

CONTENTS:

1. THE ELDO EQUATORIAL BASE D. Bagaria p 4-10 (See N70-25154 11-11)
2. NASA'S FUTURE PLANS AND PROGRAMS T. O. Paine (NASA, Washington) p 12-16 (See N70-25155 11-34)
3. PROGRESS IN OPERATIONAL PROGRAMME p 17-21 (See N70-25156 11-31)

N70-25155*# National Aeronautics and Space Administration, Washington, D.C.
NASA'S FUTURE PLANS AND PROGRAMS
T. O. Paine *In* ESRO ESRO/ELDO Bull., No. 8 Jan. 1970 p 12-16 Presented at the European Space Conf. Comm. of Senior Offic., Paris, 14 Oct. 1969
Avail: CFSTI

The future major trends of NASA programs in the second decade of space activities are described. The hope was expressed that international cooperation in space activities between the USA and European countries would increase during that period. Future NASA programs emphasize the space shuttle and orbital space station projects, and nuclear propulsion for launch vehicles was also mentioned. Among scientific programs are orbital telescopes, planetary manned exploration, and flyby missions. Applications programs such as communication, meteorological, and navigation satellites, as well as Earth resources survey missions will also be further developed. ESRO

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